BORIS ZUBKOV

HOW THE MACHINE LEARNED THE ALPHABET

ILLUSTRATED BY BORIS KYSHTYMOV

MALYSH PUBLISHERS MOSCOW

IBM

HOW TO MAKE A MACHINE THAT CAN READ AND WHY WE WRITE POSTCODES ON ENVELOPES

"My machines are good all around," man thought. "They can fly, walk, build houses and roads, dig coal out of the earth, forge things out of red-hot metal... They can do anything!"

No! Not anything. They cannot.... think.

But is it possible to teach a machine to think? Not simply dig the earth, carry loads and fell trees, but also think, solve problems and order other machines about? It's not easy to do this. Indeed, it's extremely difficult! It's much easier to make, say, a cross-country vehicle or a plane.

And yet, let us try to make the simplest thinking machine — a machine that can.... read.

"A reading machine?" you say. "Surely, that isn't possible!"

Let us not argue, but get down to business. We only need a few things to make our machine.

Three drawing pins that are used to hold paper in place.

Two torch bulbs.

One torch battery.

Two small sheets of tin and two strips of tin.

A length of copper wire.

L01.00 2UB

One cardboard box — not too large and not too small.

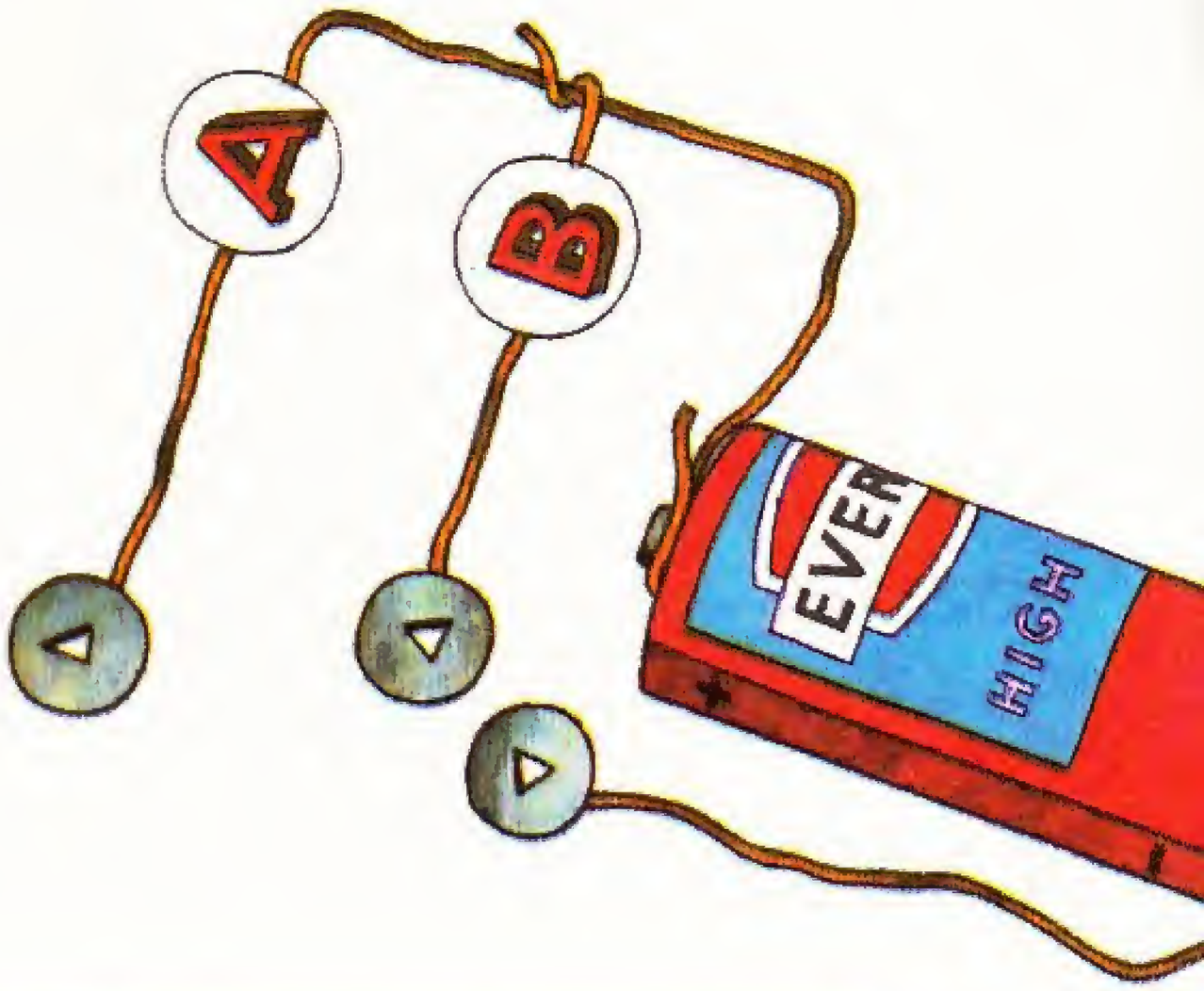
The artist has drawn the reading machine for you. Look at his drawing carefully. Press the three pins into the box exactly as shown in the drawing. Make two "windows" in the lid of the box. Paste thin paper over them on which you have drawn the letters A and B. Now cut two slits in the bottom of the box; the distance between them must be the same as the length of the battery. Bend the two tin strips at right angles and insert them into the slits. Fix the battery between them and connect the strips, the pins and the bulbs by the copper wire, as shown in the drawing. Fix the bulbs under the "windows" and.... our reading machine is ready.

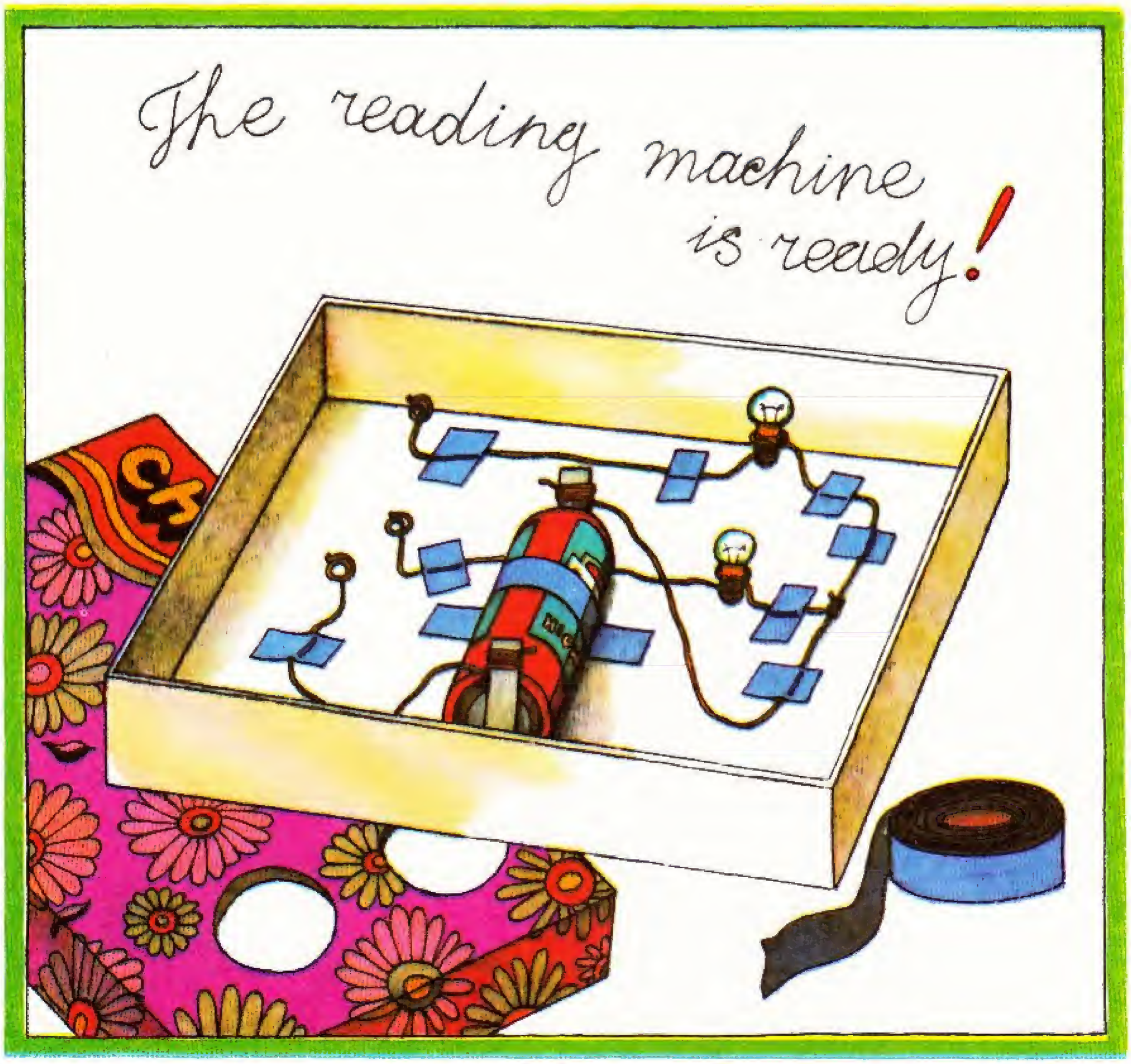
Now turn over this page and look at the drawing showing how to cut out the letters A and B from the two tin sheets.

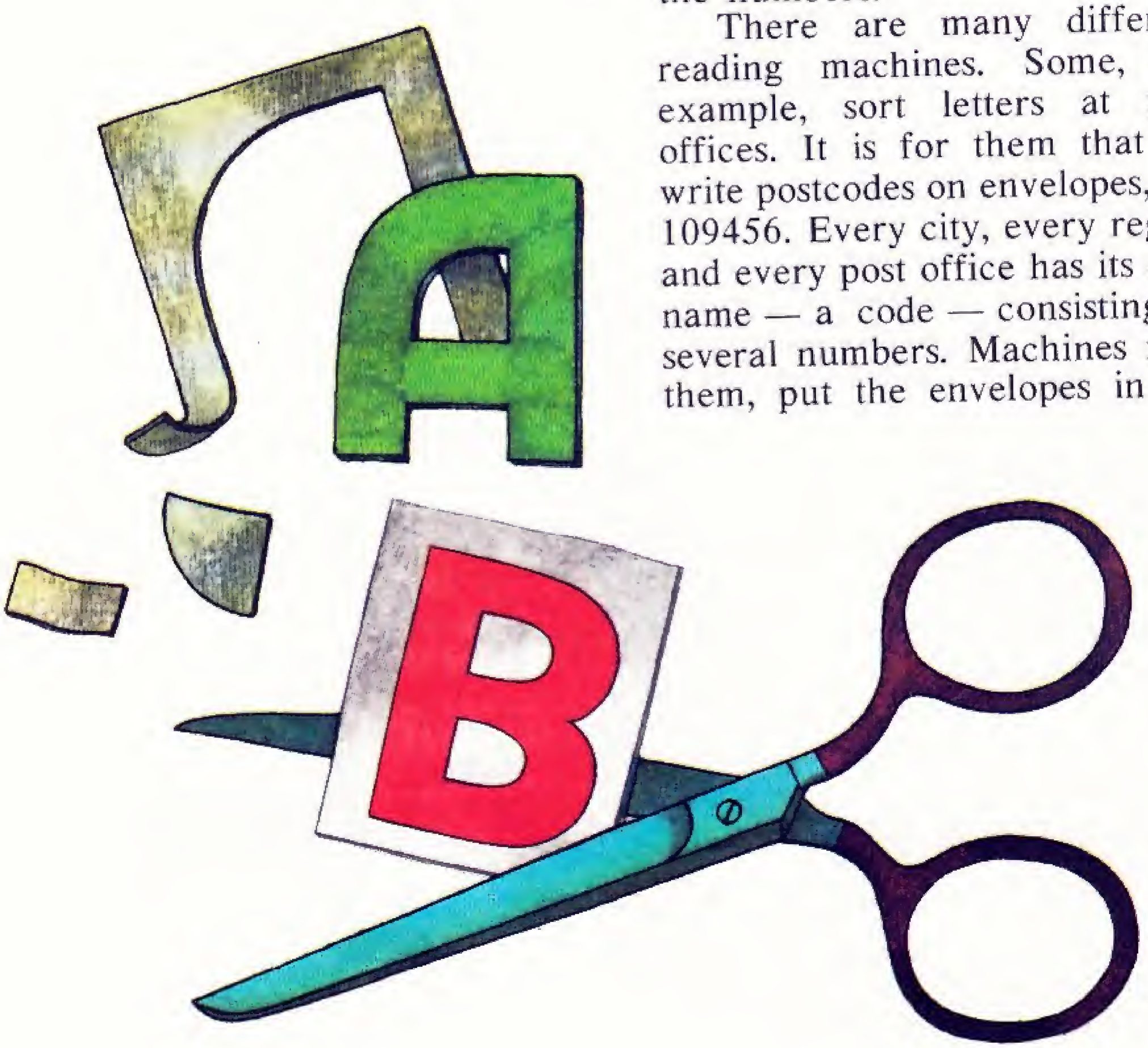
Place the letter A over pins 1 and 3 and you will see that a light will go up in the window with the letter A. Now place the letter B over pins 1 and 2. A light will go up in the window with the letter B. So the machine has "recognised" the letters. It has "read" them!

"This is A; this is B," blink the lights in the "windows"; our box recognises the letters. It's reading!

You could say that between us we have worked a little miracle: the cardboard box on our table recognises letters! Remember how difficult it was for you to learn to do that? It doesn't matter that our machine knows only two letters. You began with them, too. But the main thing is clear, that it's possible to teach a machine to read. Real machines know all the letters and all

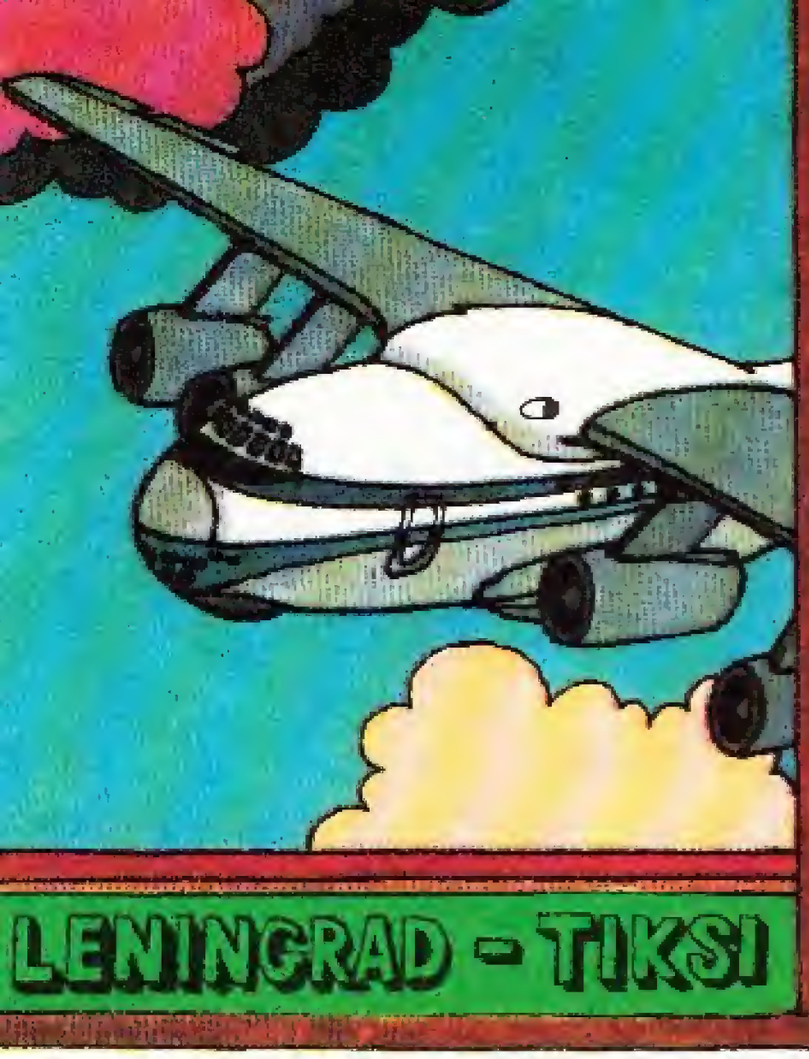




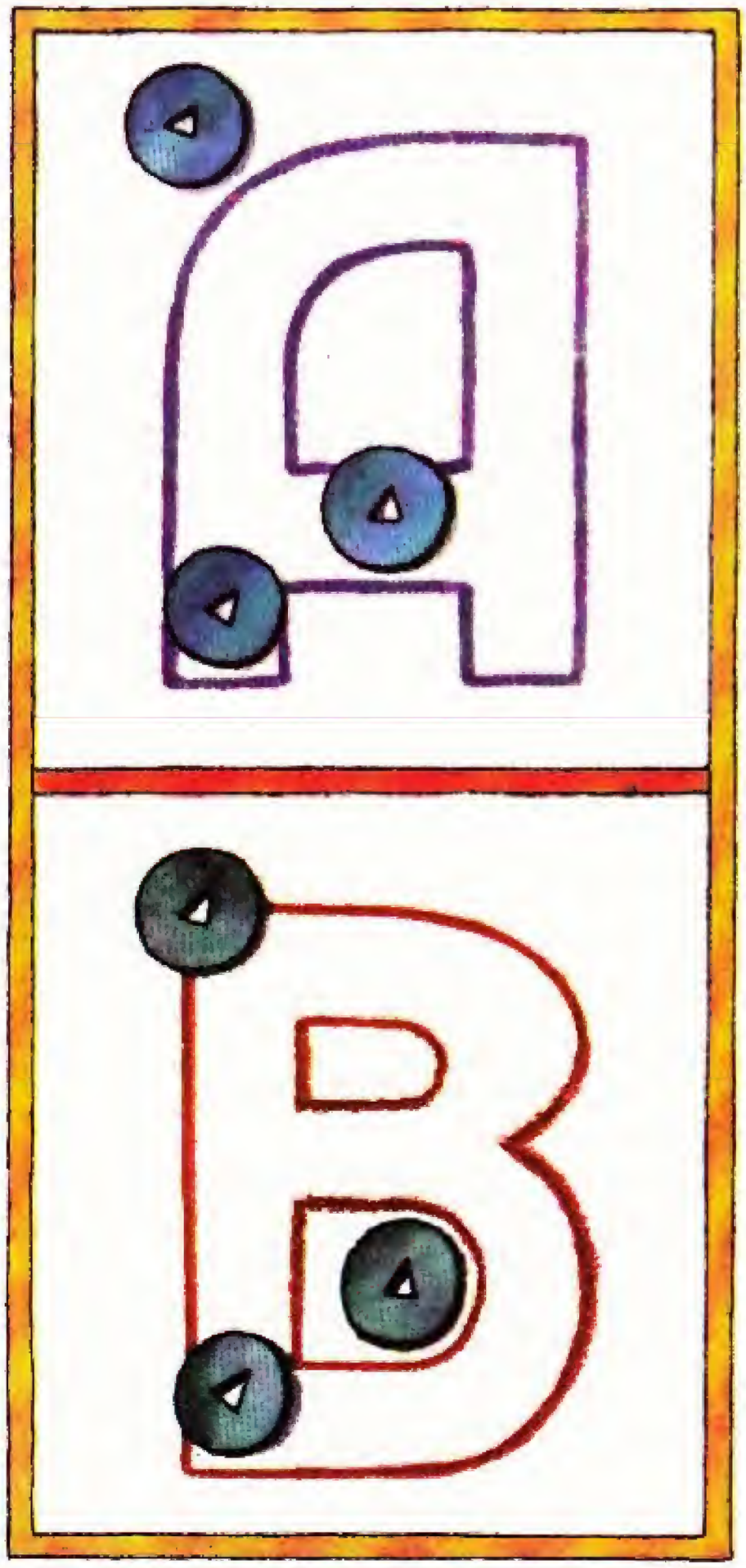


the numbers.

There are many different reading machines. Some, for example, sort letters at post offices. It is for them that we write postcodes on envelopes, say 109456. Every city, every region and every post office has its own name — a code — consisting of several numbers. Machines read them, put the envelopes in the

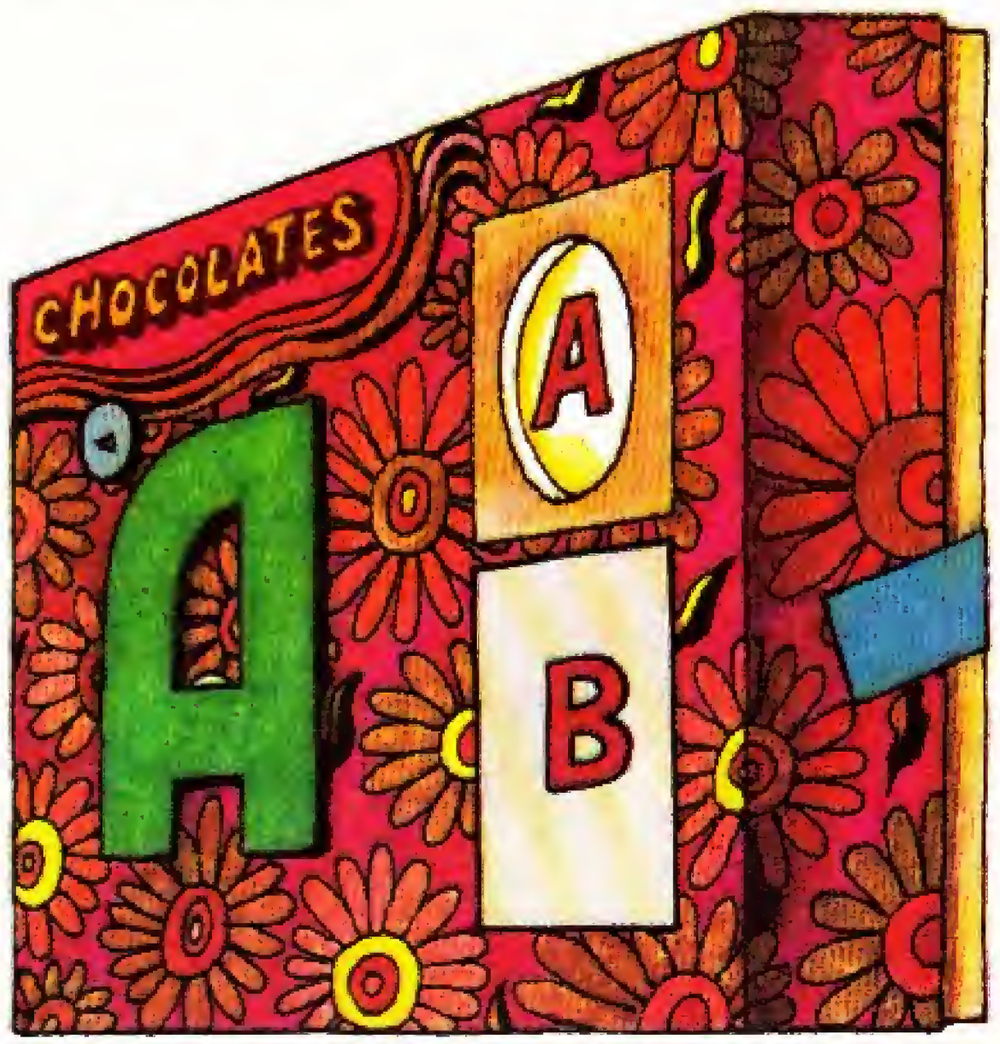


There is a postcode
on the envelope.
The machine will read it,
and trains,
ships and planes
will quickly deliver the letters.



proper pigeonholes and send them on long journeys by different trains and planes. When you write a postcode on an envelope, you are writing it for the machine and it understands you very well.

So we have taught a machine to read. But perhaps we can teach it to speak? Let us go to the following page and try to speak with a machine.



THE IMPORTANCE OF "YES" AND "NO" AND HOW PEOPLE SPEAK WITH LIFTS, MILLS, STEAM ENGINES AND ROCKETS

There is a game called "Don't say Yes or No and don't take Black and White." We are going to play a different, but very similar game. Let us call it "Yes or No — No or Yes." I'll ask you questions and you must reply either Yes or No. Nothing else! Agreed? Then off we go!

"Do you go to school by bus?"

"No."

"Do you walk?"

"Yes."

"Do you walk along Three Poplars Road?"

"No."

"Along Cherry Street?"

"Yes."

"Do you cross Quiet Lane?"

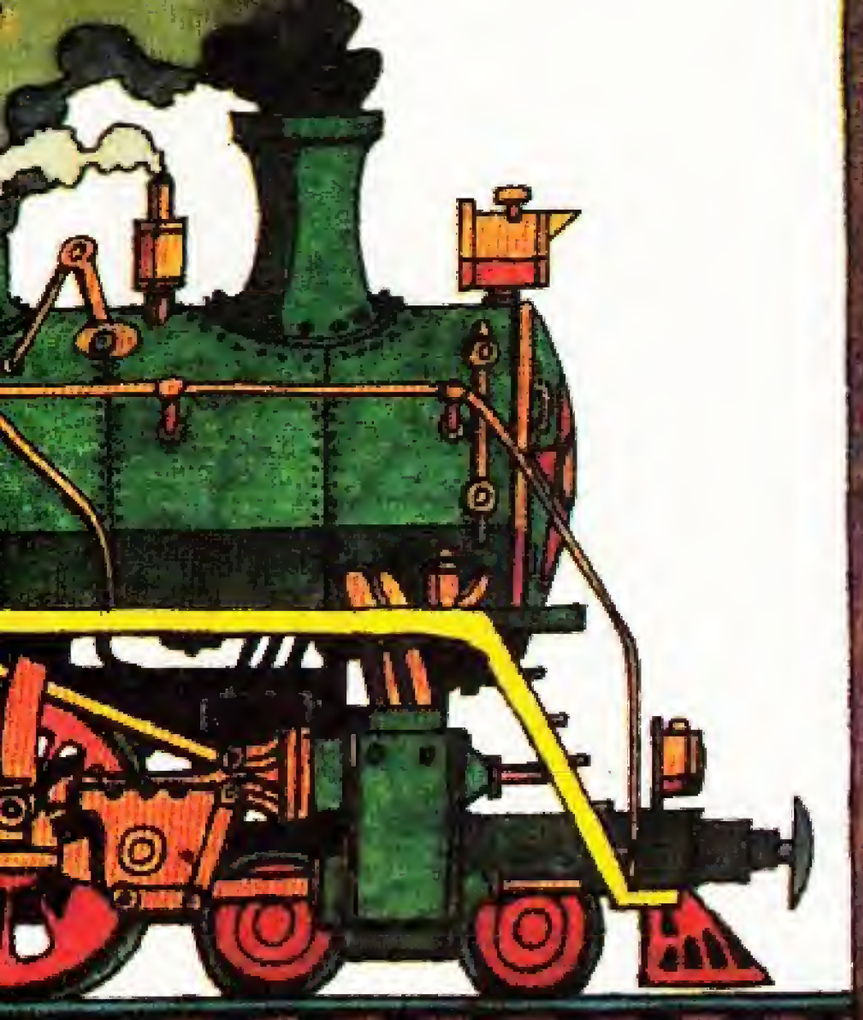
"No."

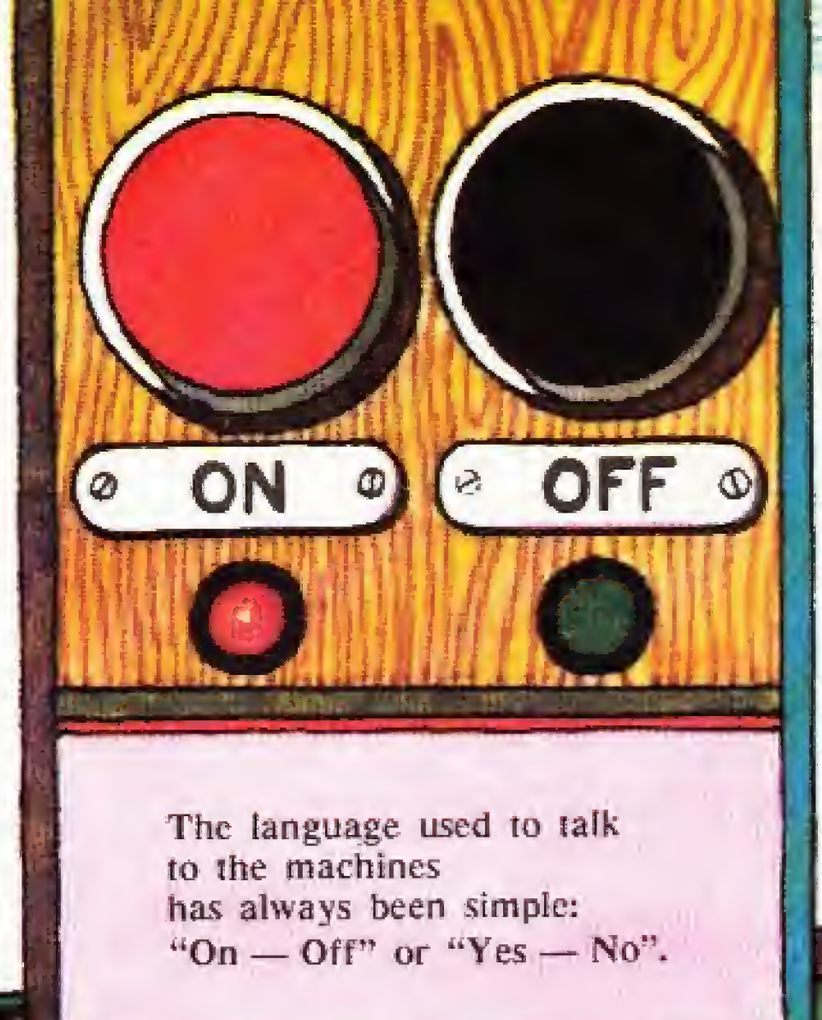
"Do you stop at the corner?"

"Yes."

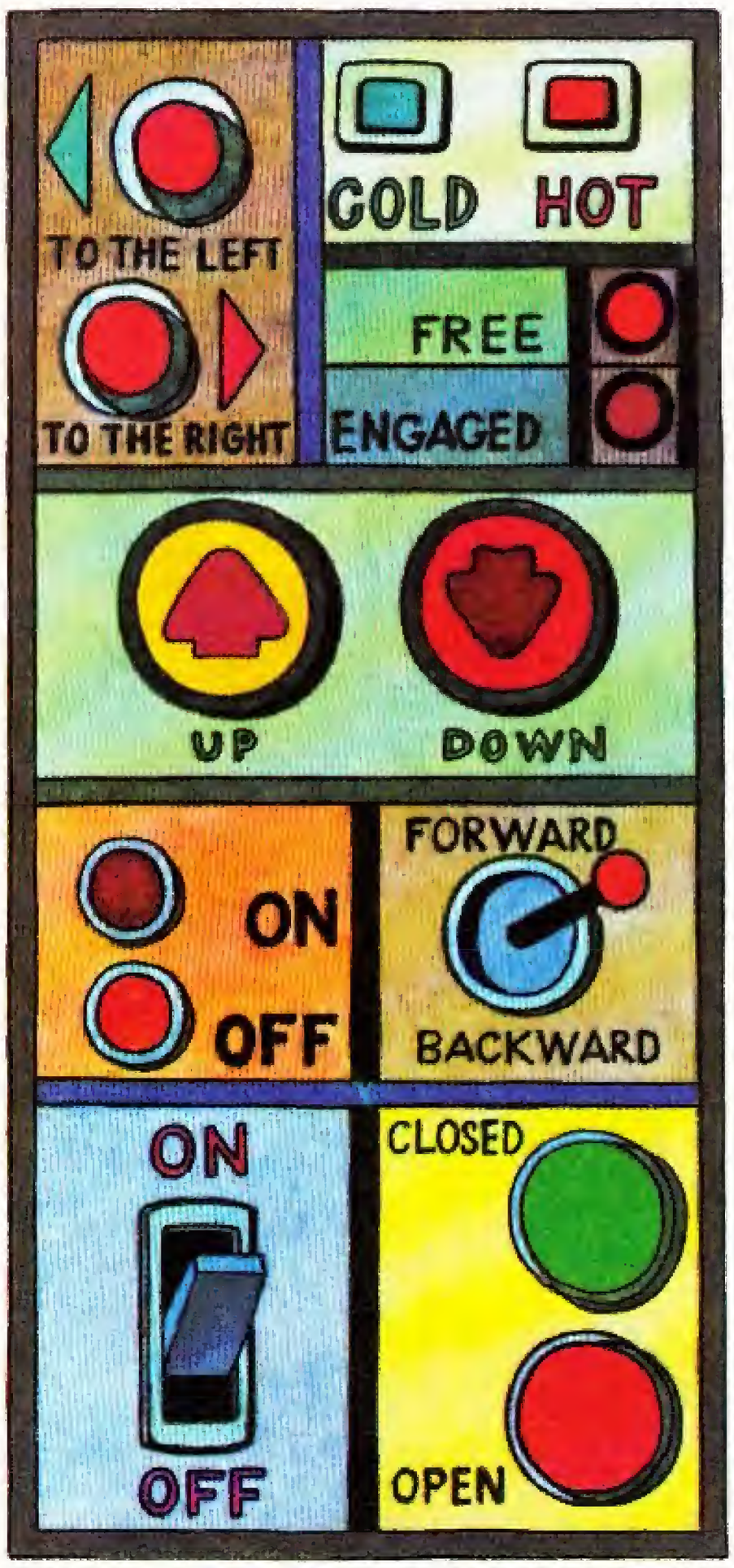
So your school is at the corner of Cherry Street and Quiet Lane. Our conversation was a strange one, of course. I asked you questions and you said only "yes" or "no". But if you think it wasn't a serious conversation, you're wrong: it was very serious. First of all, I have found out

Walk — Don't walk.
On — Off. Yes — No.
In this way we and the machines understand one another.





The language used to talk
to the machines
has always been simple:
"On — Off" or "Yes — No".

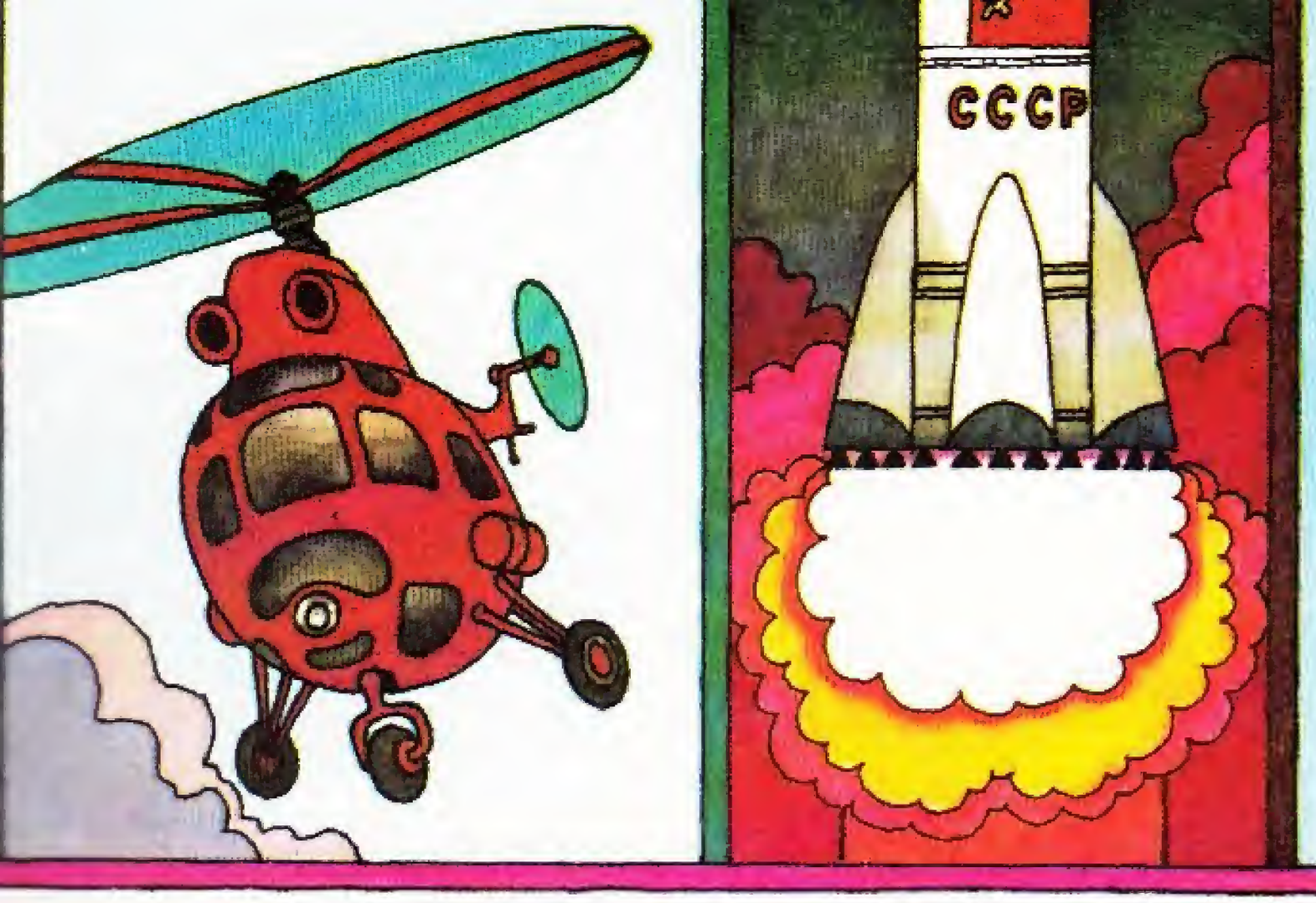


where your school is, its exact address. Second, and most important, this "yes — no" language can easily be used to talk with any machine. You yourself have been speaking this "yes — no" language with machines for a long time. You don't believe me? You simply haven't noticed it.

You have to go to the ninth floor. You approach the lift. The red light is on. The lift is saying to you, "I'm engaged. Wait, please." Now the light has gone off. The lift is saying, "Press the button and I'll come down in a minute." So you have talked with the lift. And just by a light going on and off. Engaged — free. Yes — no.

For a very long time man's conversations with machines were exactly like this — very simple. Just two main commands, "Start!" and "Stop!"

The miller would press a creaking wooden lever and the wind would turn the sails of his mill and the millstones would grind the corn into flour. The engine driver would pull a steel handle



Now the "Yes — No" commands are more and more often replaced with commands in numbers: "1—0".

and his engine would puff out of the station, sending up clouds of hot steam and cascades of sparks. The cosmonaut said, "All systems go!", they pressed a button and the first manned spaceship rose into the sky.

Machines became more and more complicated and intelligent.

But it was man who made them.

And it was man who taught machines to understand him.

It's easy for man to talk to machines in the "yes" or "no" language.

Start! — Stop!

On.— Off.

Engaged.— Free.

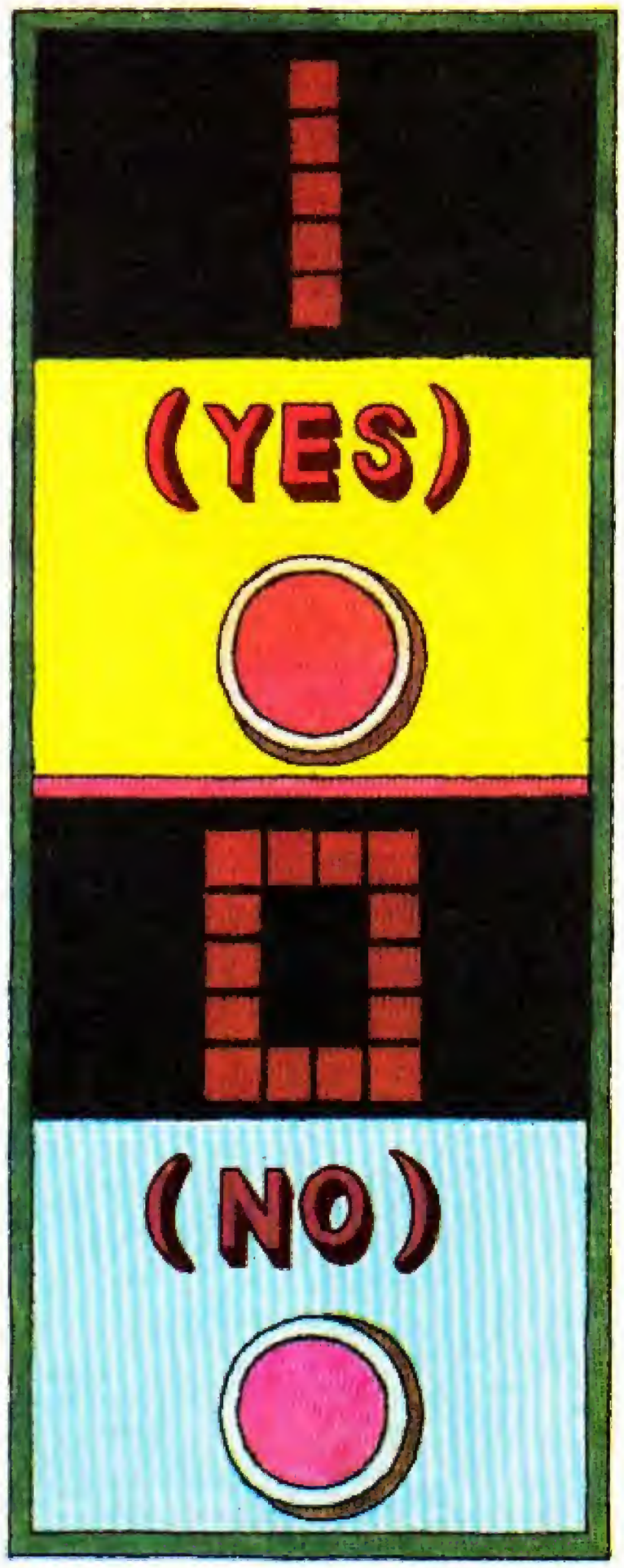
Left.— Right.

Up.— Down.

Yes.— No.

It's even simpler to replace such words with the number one and the number nought: 1 and 0. Knowing and recognising these two numbers alone, a machine can understand what man wants to say, order or ask.

Now a few words about a machine and.... a cat.



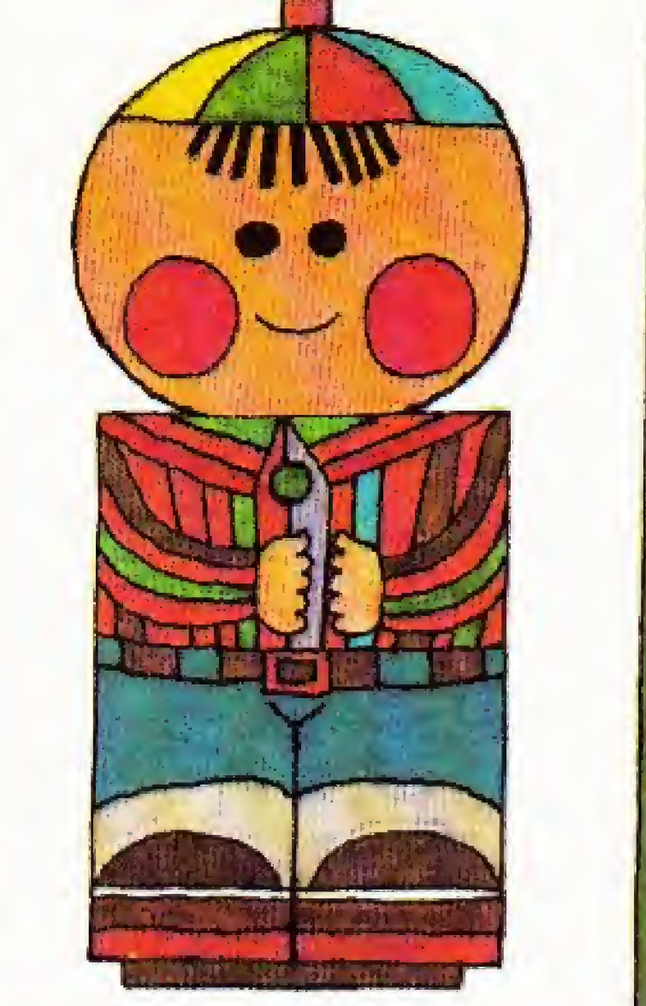
HOW MACHINES LEARNED THAT A CAT WAS A CAT AND WHY PEOPLE BEGAN CALLING MACHINES "INTELLIGENT"

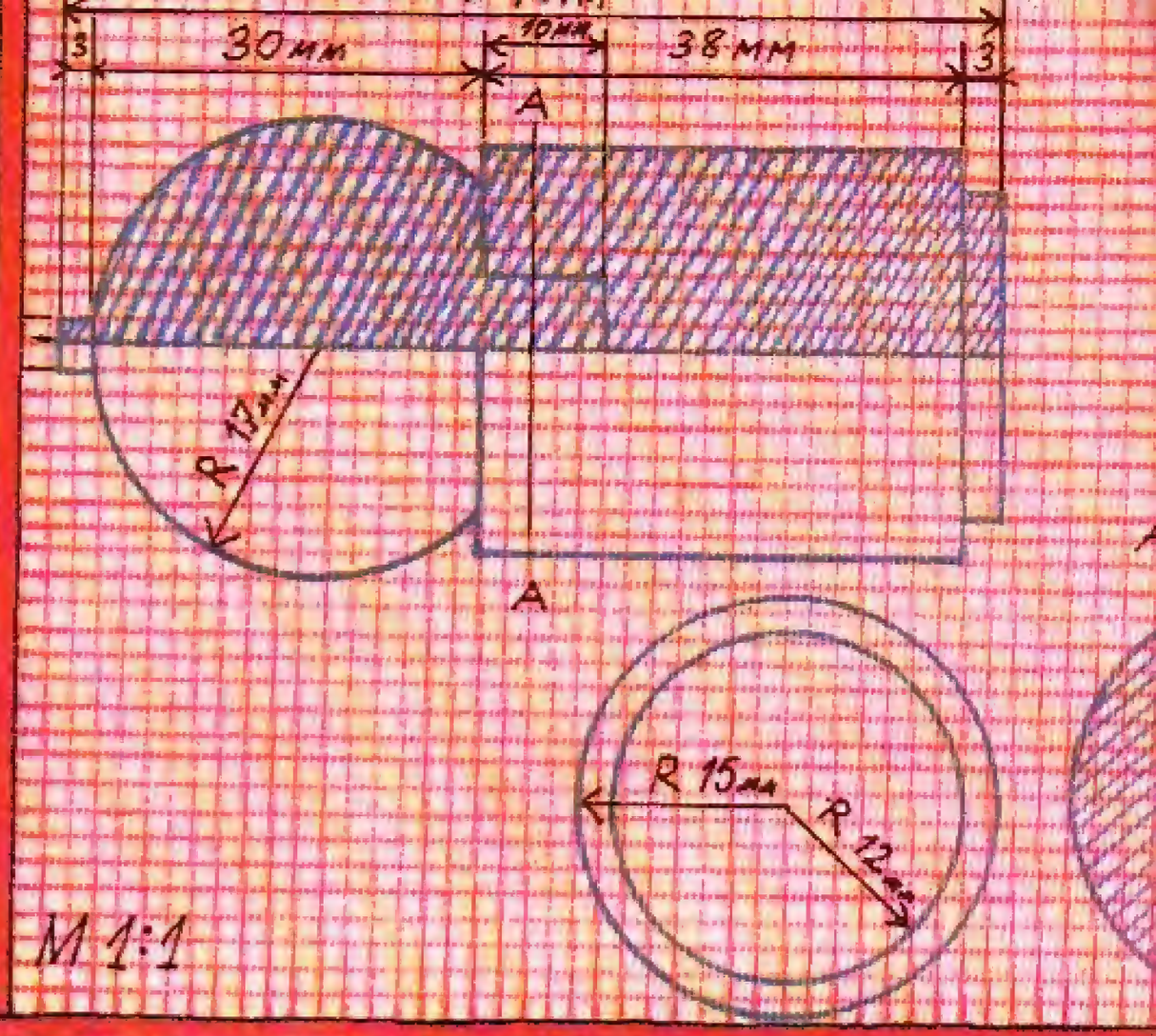
et us draw a cat for.... a machine. Not a usual cat.... This is what it looks like.... The cat is drawn in squares, like on graph paper. There is a reason for this. You can see that some of the squares are empty and light, while others are shaded and dark. Now let's draw small squares on the paper beside the cat and play one more game, like "noughts and crosses".

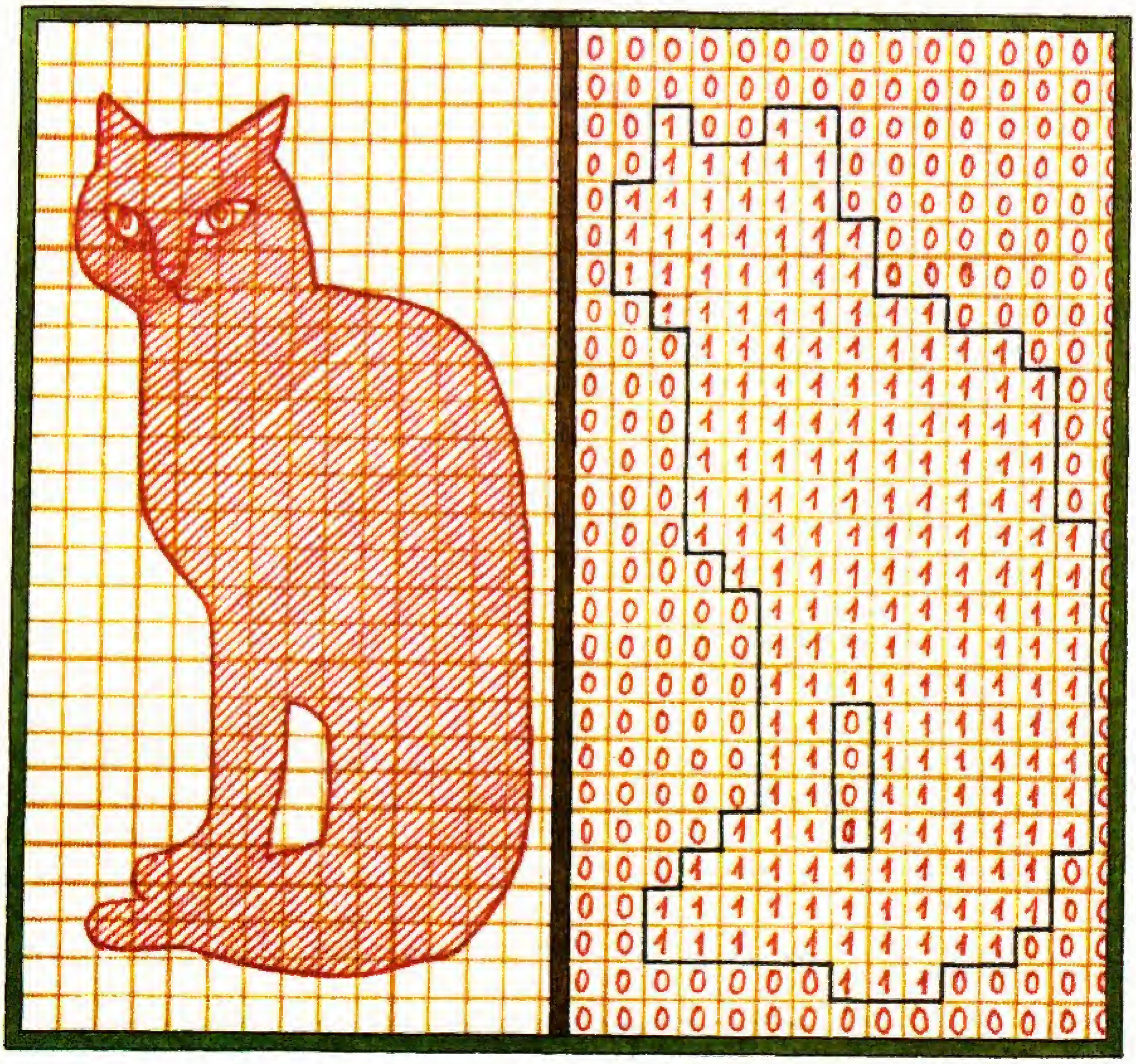
Look at the cat. The square in the top left-hand corner is empty and light. We shall write a nought — 0 — in the same empty spaces of the squared paper beside the cat. Now come the shaded and dark squares. We shall write the number "one"—1—in the same spaces of the squared paper.

Continue square by square until the end.

Beside your cat there will be columns of the numbers 0 and 1. And your cat will no longer be a cat, but lots of noughts and ones, lots of "ons" and "offs". The machine understands this. It has been taught this. So it will recognise and pick out the cat. Of course, it's much easier said than done. It




3
30 мм
10мм
38 мм
3
A
A
R 17мм
R 15мм
R 12мм
M 1:1



These are cogwheels.
A machine will recognise
this drawing, read it, remember it
and make a thousand
of exactly the same cogwheels.

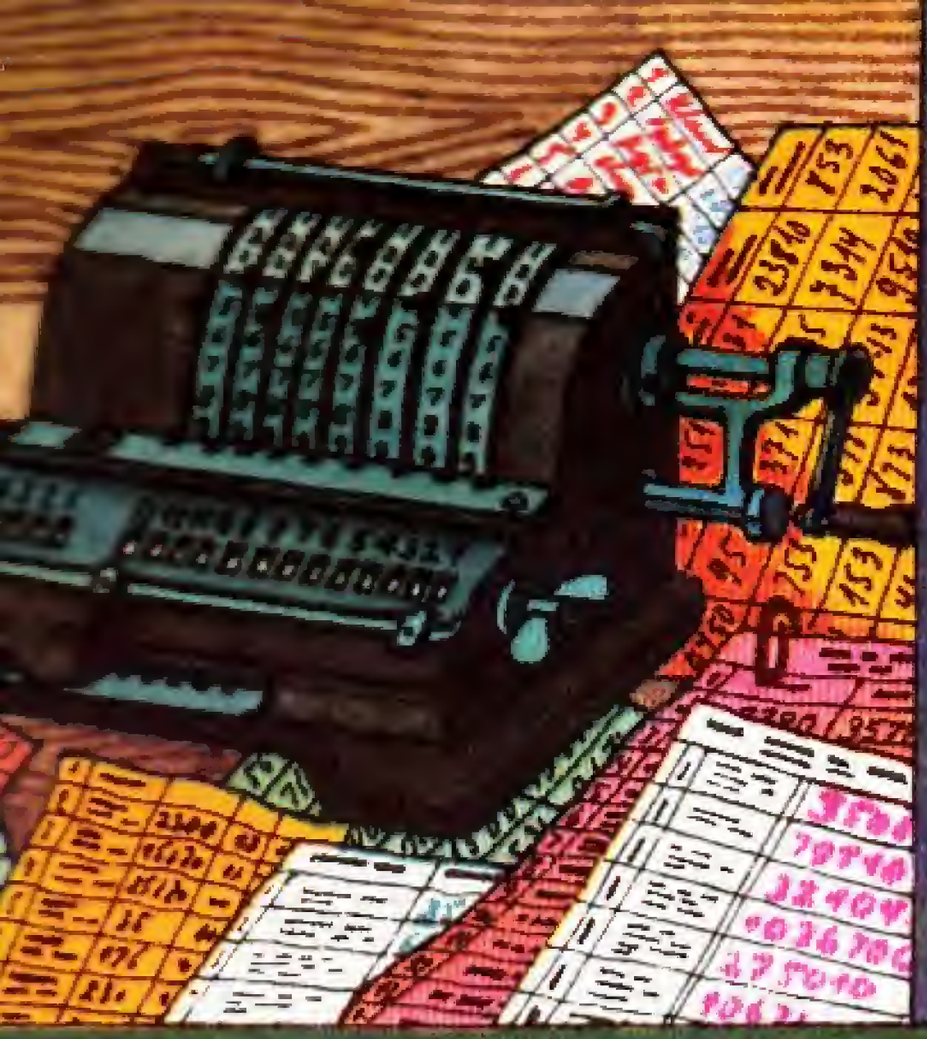
was very difficult to make a machine that learned to understand things drawn on paper.

All sorts of things were drawn for the machine! It was shown so many pictures: triangles, stars, birds, clowns and baby mice. And the machine recognised all the pictures!

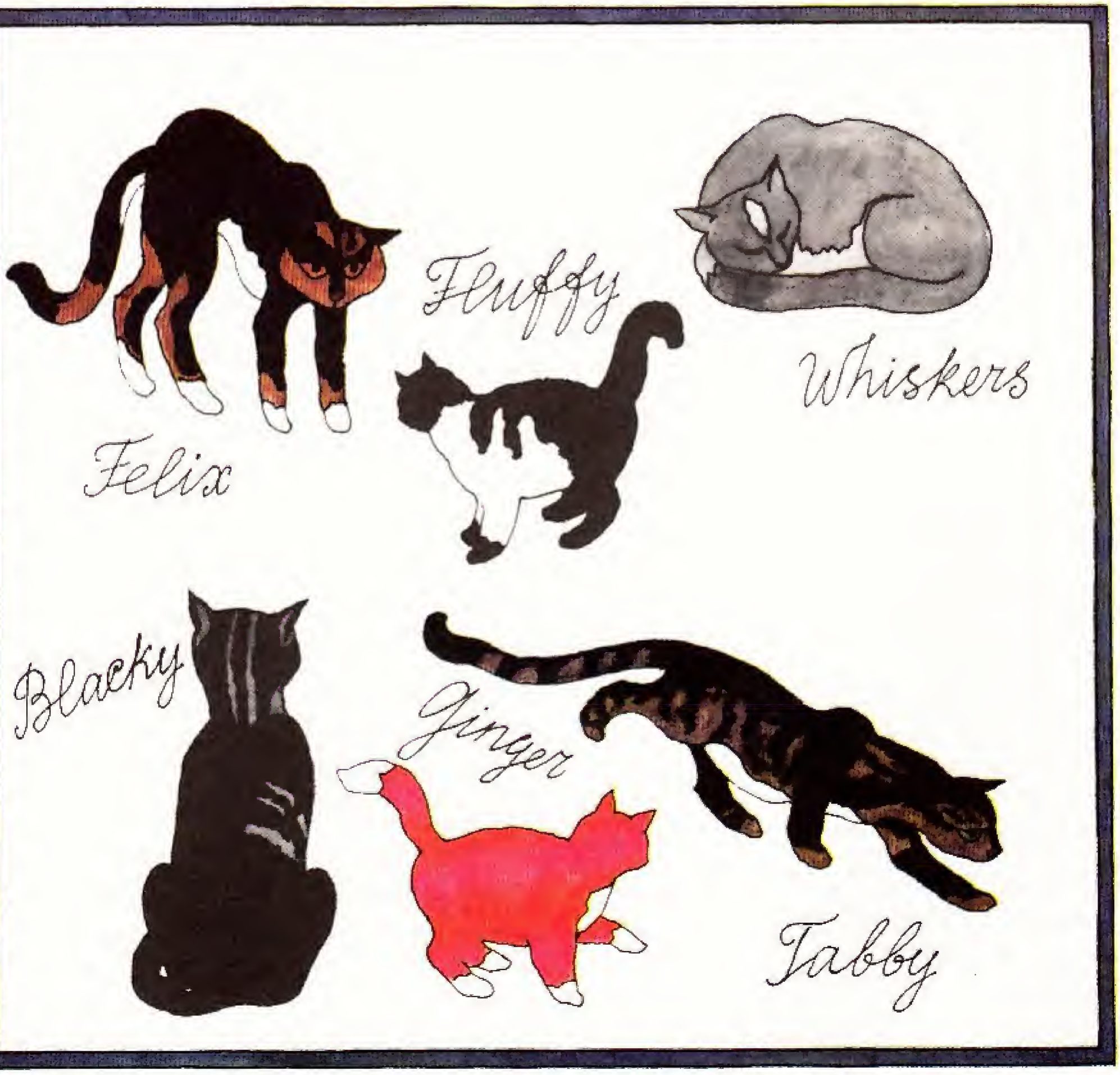
Later man taught machines to make out numbers, read letters and understand technical drawings. People began calling machines "intelligent". I wrote that word — "intelligent" — and set to thinking.

Look at all the different cats the artist has drawn. If you show any picture of a cat to the smallest child who cannot even speak properly, he'll say at once, "Pussy!" But the machine knows only one cat — the one drawn specially for it. After all, we turned only that cat into the noughts and ones that the machine understands.

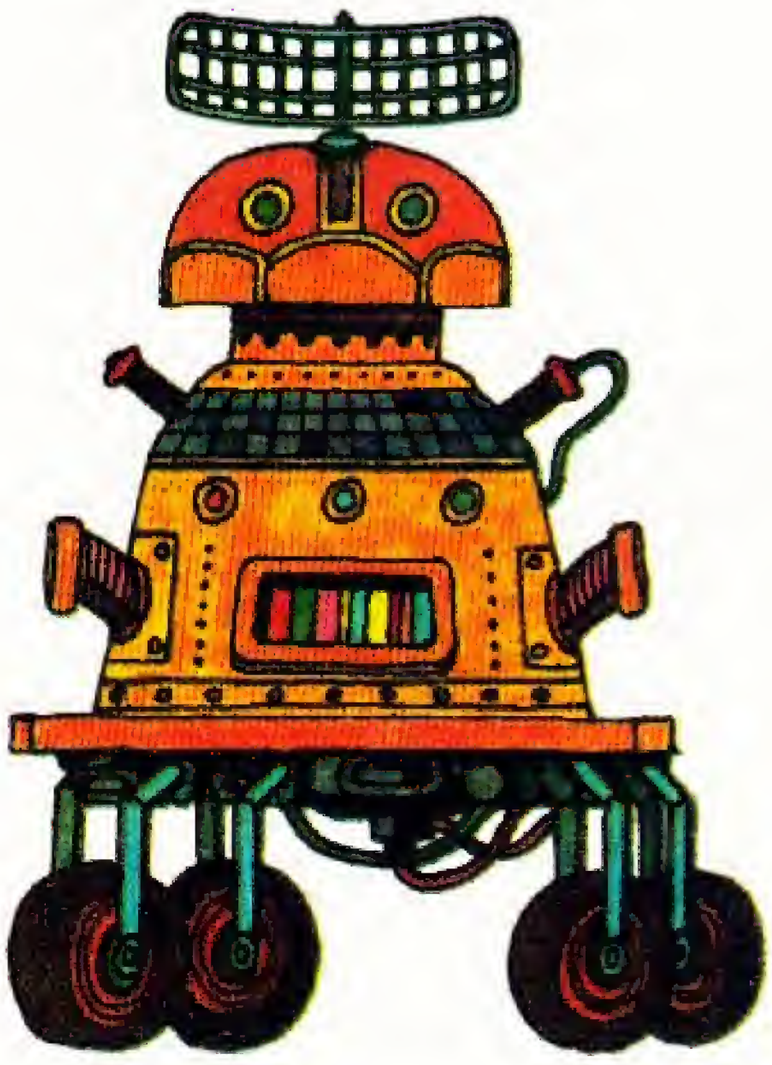
So it turns out that sometimes a child can understand and do more than the cleverest machine.



It's not easy
to count and calculate.
To make it easier,
man first invented
counting sticks,
then a rope with knots
and an abacus
with counters;
then he created
an arithmometer
with tiny cogwheels
and then a small
electronic calculator —
microcalculator.



IRON DUCKS AND TRUMPETERS, WHAT IS AN "AUTOMATON" AND HOW MANY AUTOMATONS THERE ARE AROUND



"Quack, quack!" said the duck and fluttered its iron wings.

Yes, the duck was made entirely of iron. It drank water, moved its head, quacked, fluttered its wings and even pecked grain. It was amazing!

"Ta-ta-ta-ra!" trumpeted the trumpeter, clasping his trumpet in his iron hand.

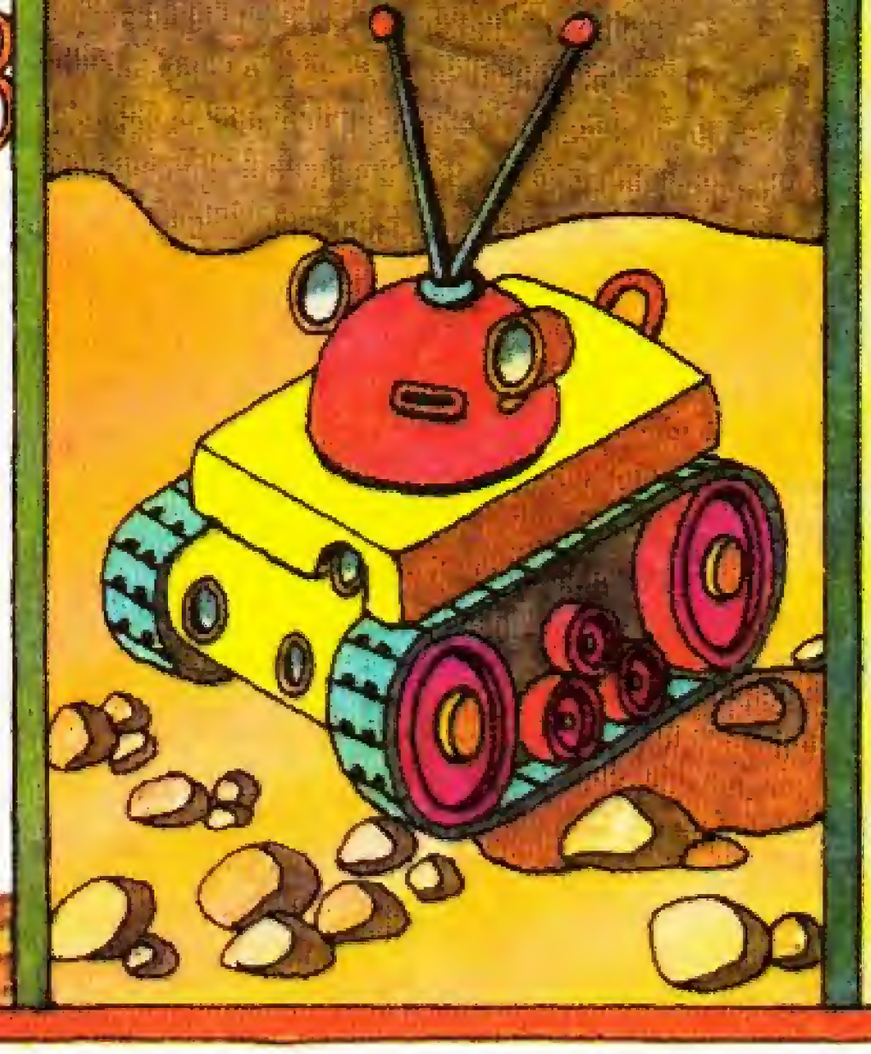
The iron draughtsman made no sound. He was busy, drawing a tree with a pencil which he held in his iron hand. And he blew hard on the paper, blowing off the dust.

Townsfolk, peasants, kings, queens, tramps, soldiers, boys and old women—all hurried to see the iron trumpeter, the duck and the draughtsman. Everybody was astonished to see a baker putting bread into a stove, not a real one of course, and a barber, deftly clicking his scissors. Mind you, nobody risked asking him for a haircut.

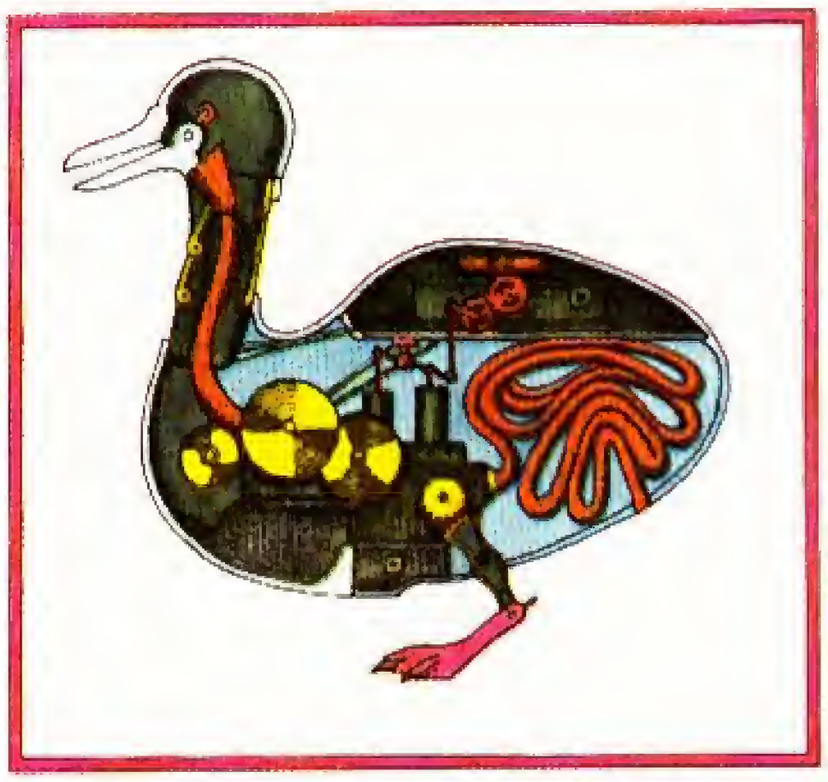
Today these dolls are on display in museums. It's as if they have been forgotten. But no! They are not at all forgotten.

"Tr-r-ring! Tr-r-ring!"

You don't want to wake up. You don't want to get up. But the alarm clock in-



These are simple
automatic machines.
The mechanical birds
flutter their wings.
The draughtsman draws.
The toy cross-country vehicle
crawls along.
There are springs, levers and cogwheels
inside these automatic machines.



Clockwork toys
imitated live people
and birds
very closely indeed.
About two hundred years ago
clever master craftsmen
made clockwork animals and birds
so skilfully
that they could be mistaken
for live ones.

sists, "Wake up!" It was set last evening and now it rings **on its own.** What a clever, independent clock!

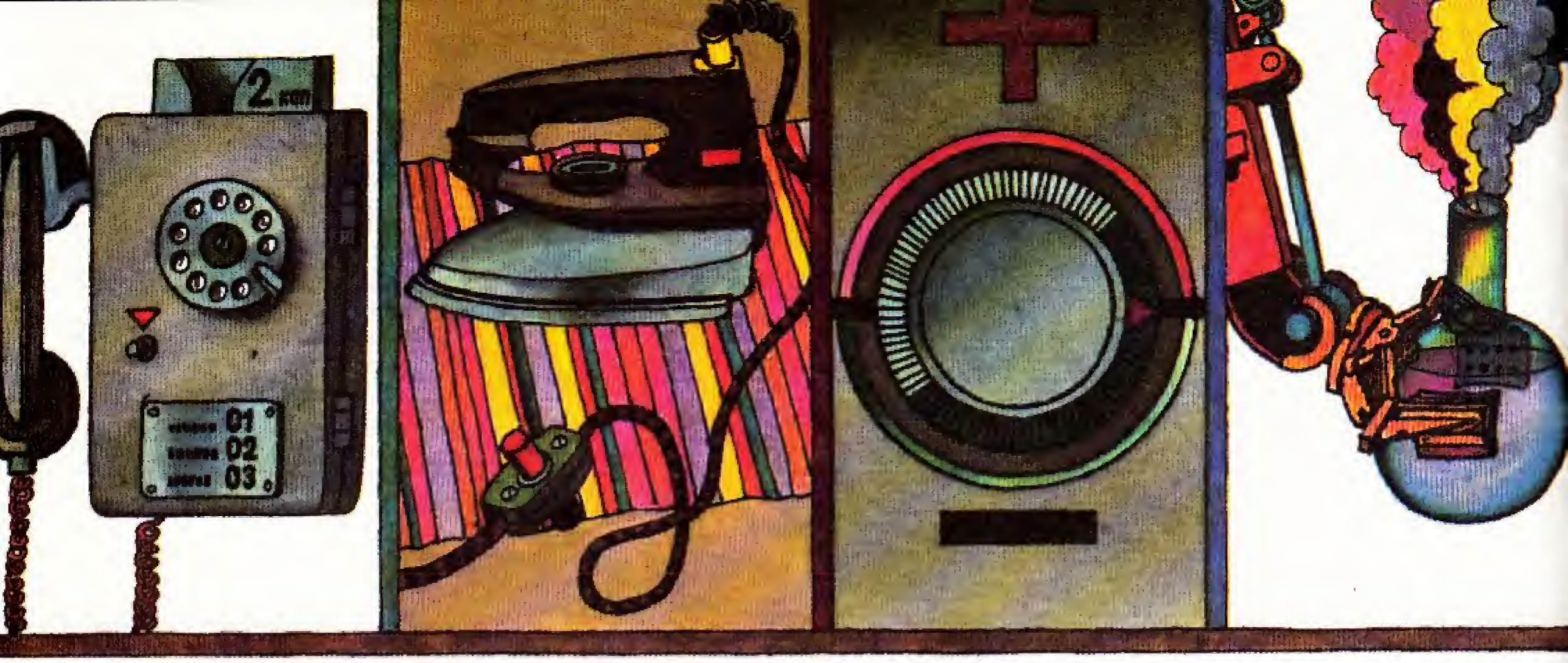
Off you run to school. But you stop at the crossing. The red traffic light looks at you steadily. Now the red light goes off and the green light goes on **by itself.**

"Psss-sh!" a jet of fizzy water squirts into the glass. A shiny metal box selling fizzy water is an automatic slot machine — an automaton.

The word **automaton** has appeared in this book for the first time. It comes from the Greek word **automatos,** which means "acting independently". A machine which acts independently!

You drop a coin into the slot, press the button and give your command, "Raspberry-flavoured!" The automatic slot machine will never make a mistake. It will give you a glass of raspberry-flavoured fizzy water, and not orange-flavoured or any other!

You wind up your alarm clock, press the button and order, "Wake me up in the morning!" When morning comes, the clock will ring by itself. Automatically!



The iron trumpeter and the baker were also automatic — automatons.

You see alarm clocks and traffic lights every day. But there are thousands of other, very different automatic machines which you don't see. And yet they go out of their way to help you all day long. And they take good care of you.

Automatic pumps bring cold and hot water to your flat. You have washed and put on your trousers and jacket. The material for them was woven by an automatic loom. Even the buttons and the buttonholes were made by automatic machines.

Your breakfast is on the table. The rolls were baked at an automatic bakery. The milk was poured into the bottle by an automatic machine. Even sweets are neatly wrapped up by an automatic wrapping machine.

Automatic machines have helped to make this book, too. They have photographed the pictures, put the letters together to form words and printed the book, using coloured ink.

All these automatic machines had to be told beforehand exactly what to do, when to finish one task and begin another and what to remember all the time.

Like a teacher, man gives automatic machines lessons to do. And the machines understand man.

Man has flown into the sky. Beside him are automatic helpers: his aeroplane is piloted by an automatic pilot.

Now man has a new dream of flying to distant planets. But first he sends out automatic scouts — unmanned probes. An automatic interplanetary station is on the launch pad: three, two, one, zero! Lift off!

Automatic machines
always help us everywhere.

WHY A ROBOT IS CALLED A ROBOT, ONE SCIENTIFIC EXPERIMENT AND WHAT KIND OF ARMS AND LEGS ROBOTS HAVE

The word "robot" was thought up by a science-fiction writer. In one of his books he gave this name to an amazing automatic machine that looked like a man. It only lacked hair, which saved it visits to the barber's. Scientists, engineers and writers the world over liked the word "robot". Like the Russian word "sputnik", it is known all over the world. Artists like drawing amusing mechanical men.

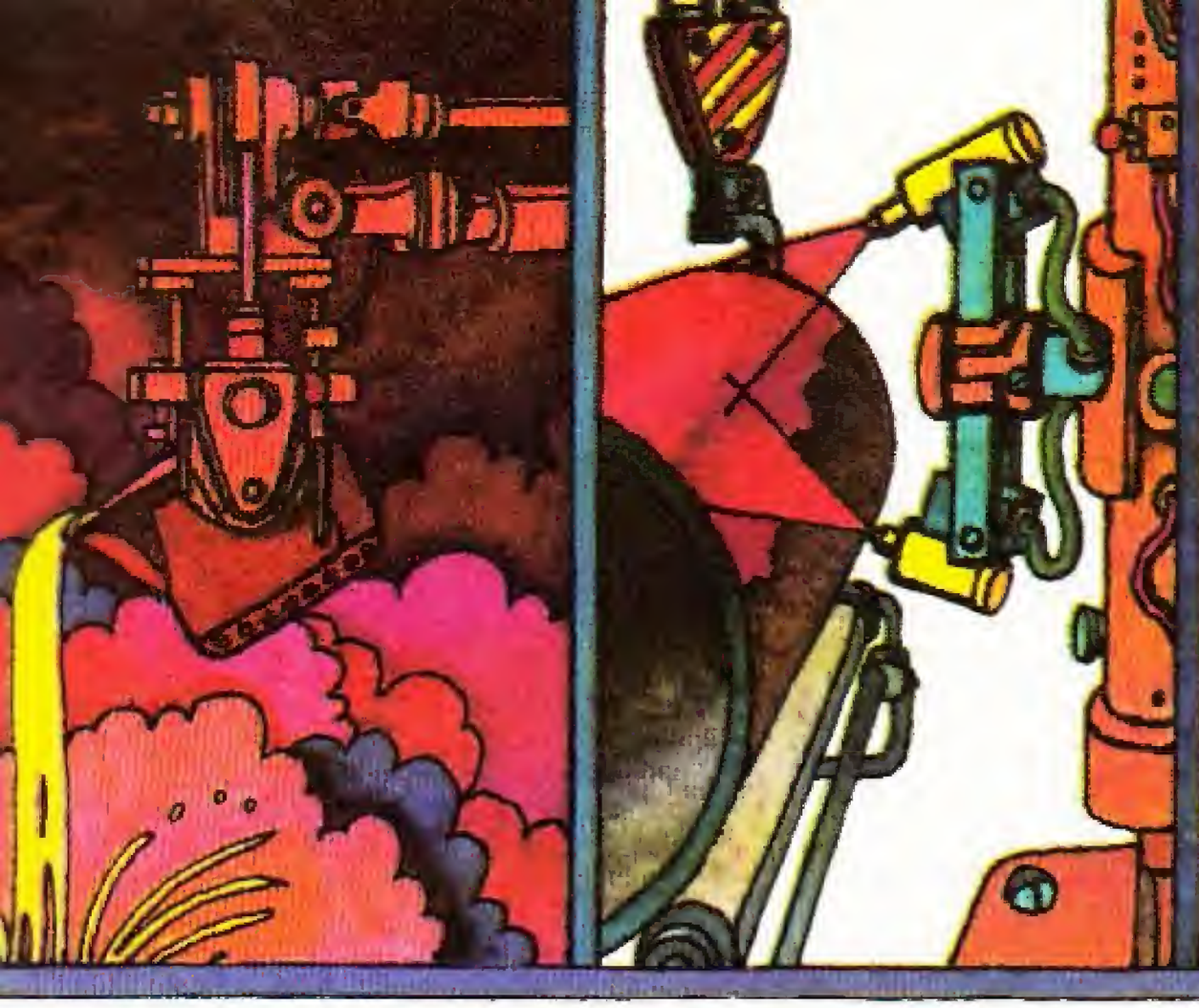
But drawing them is one thing, making them is quite another.

What should a robot be like?

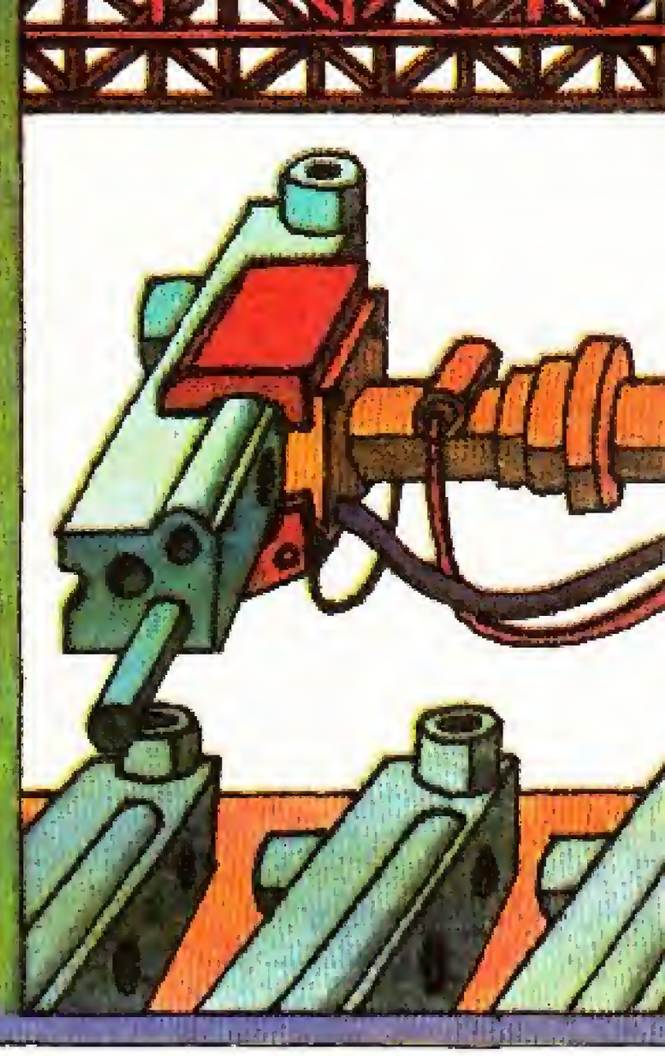
It must be able to read and make out drawings and pictures. It must understand man. You already know that such a machine can be made.

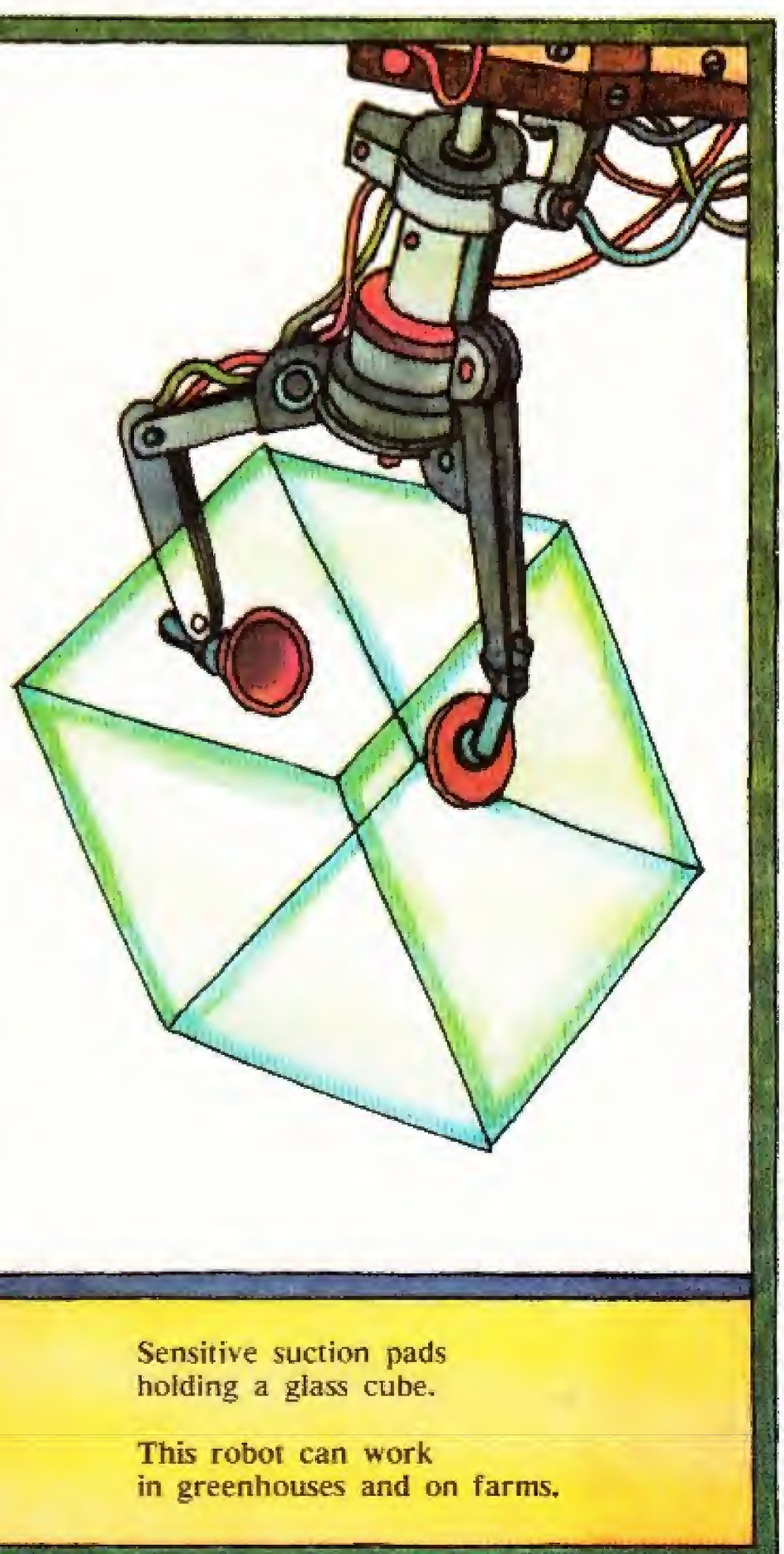
But a robot must also have hands so that it can work with them like a man. What wonderful things hands are! Simply marvellous! You will see it for yourself in a moment.

Let us conduct a scientific experiment. Yes, yes. A strictly scientific and very serious experiment with children's building bricks. If they are packed in a box, then everything is ready. One, two, three! Off we go!



Robots can do anything
from planting
delicate plants,
pouring out molten metal
and painting machines
to checking
whether bolts and nuts
have been screwed up
properly.





Sensitive suction pads
holding a glass cube.

This robot can work
in greenhouses and on farms.

Empty the box on the floor. The bricks will roll and scatter in all directions.... Collect them and.... put them back into the box.

Have you finished?

Empty the box once more.... Collect the bricks! Quick.... Quicker.... One is left.... Quicker.... Now you've pushed it in place. Finished! You've collected them very quickly. Well done!

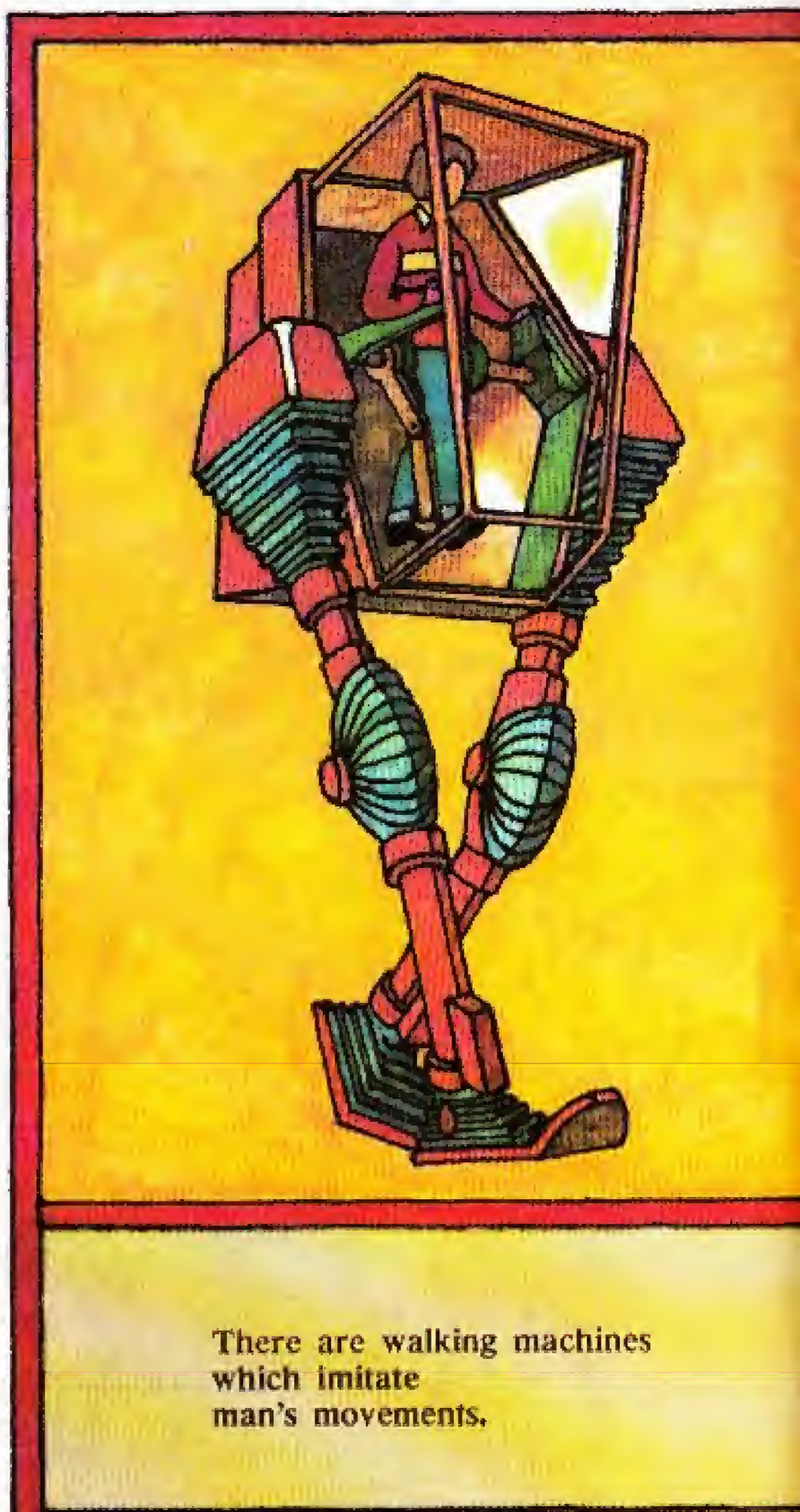
But what about the scientific experiment? It has already begun, but you were in such a hurry that you didn't even notice.

Let us empty the box once again. This time don't hurry. Collect the bricks very, very slowly. And watch your hand and your fingers closely. It is very interesting to watch them working.

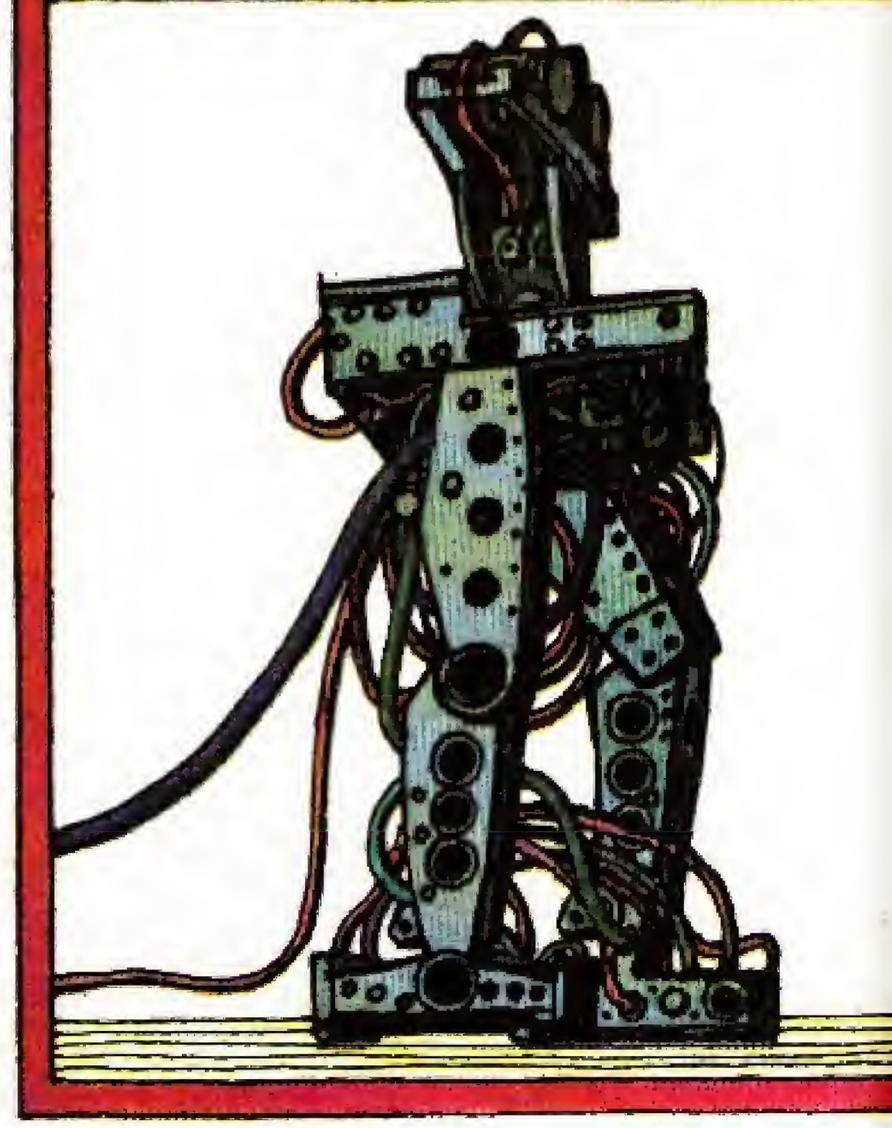
...Your hand is over a brick, the fingers feel it: there it is — a wooden brick with hard edges. Your hand turns slightly to get a better hold of it. The fingers lift the brick and carry it to the box. The brick touches the bottom of the box. The fingers sense this and let go. Now the hand moves for a second brick. Oh, it's so inconvenient.... It's too far and the hand cannot reach it. The fingers bring the brick nearer, turn it and seize it!... Now the brick is in the box, lying beside the next. The fingers feel that the bricks are close to each other: there is no need to push them together....

Your fingers press, touch, feel, push and grip many, many times. And even when they are working fast, they do not make a mistake. Such are your ten skilful helpers.

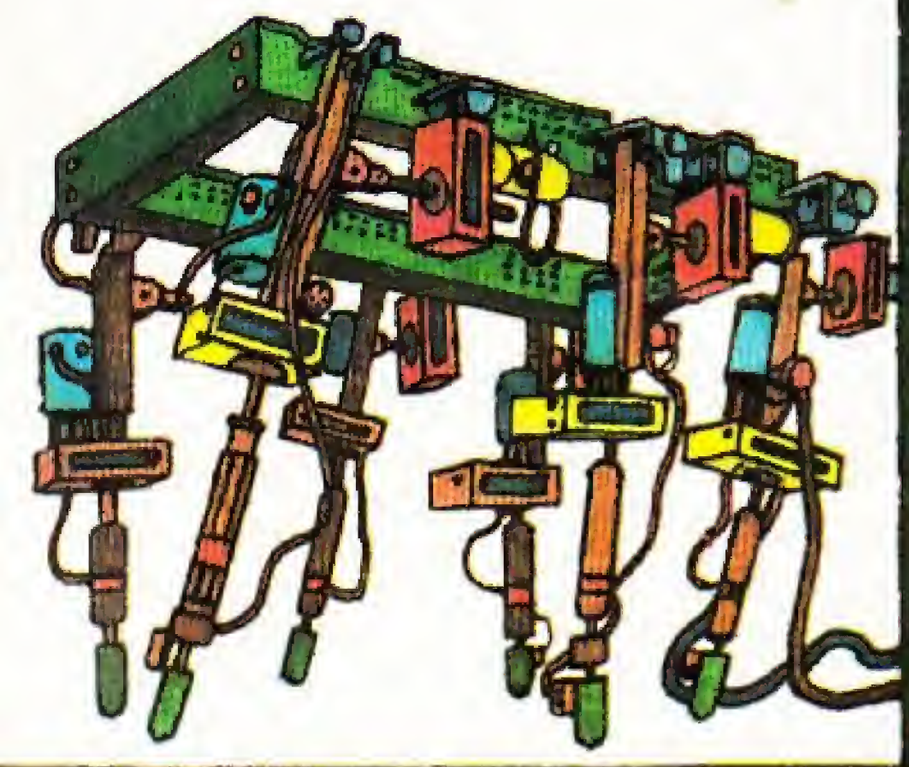
Put a potato, a crumpled-up ball of

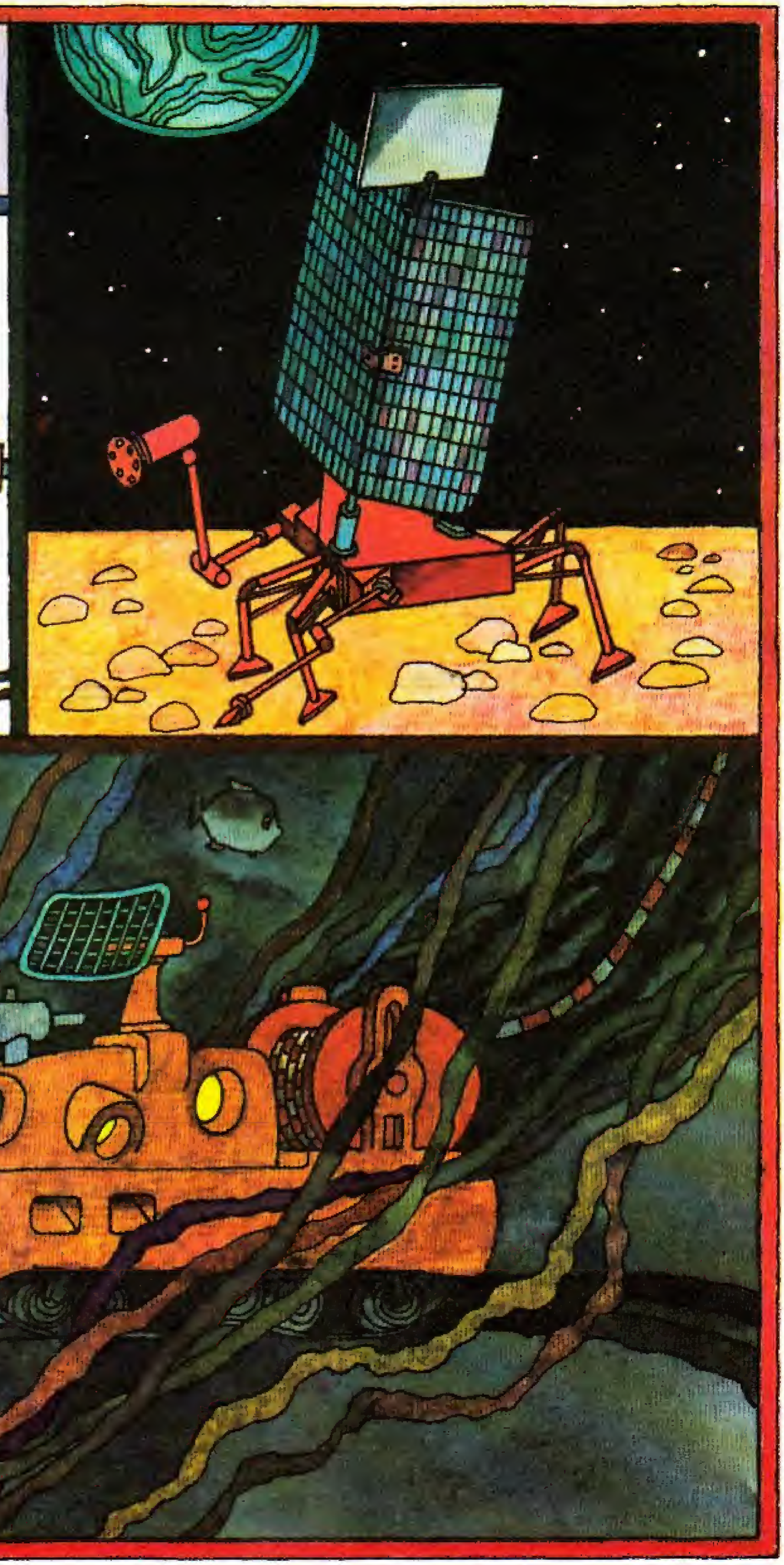


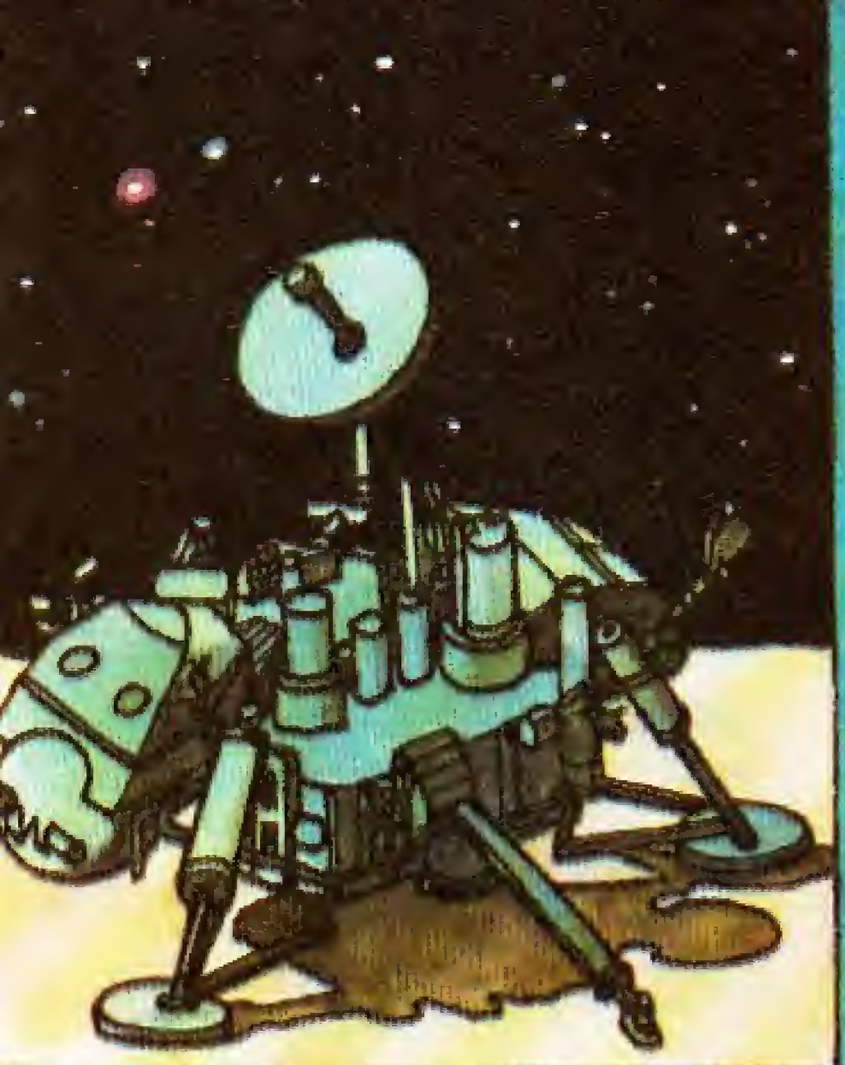
There are walking machines
which imitate
man's movements.

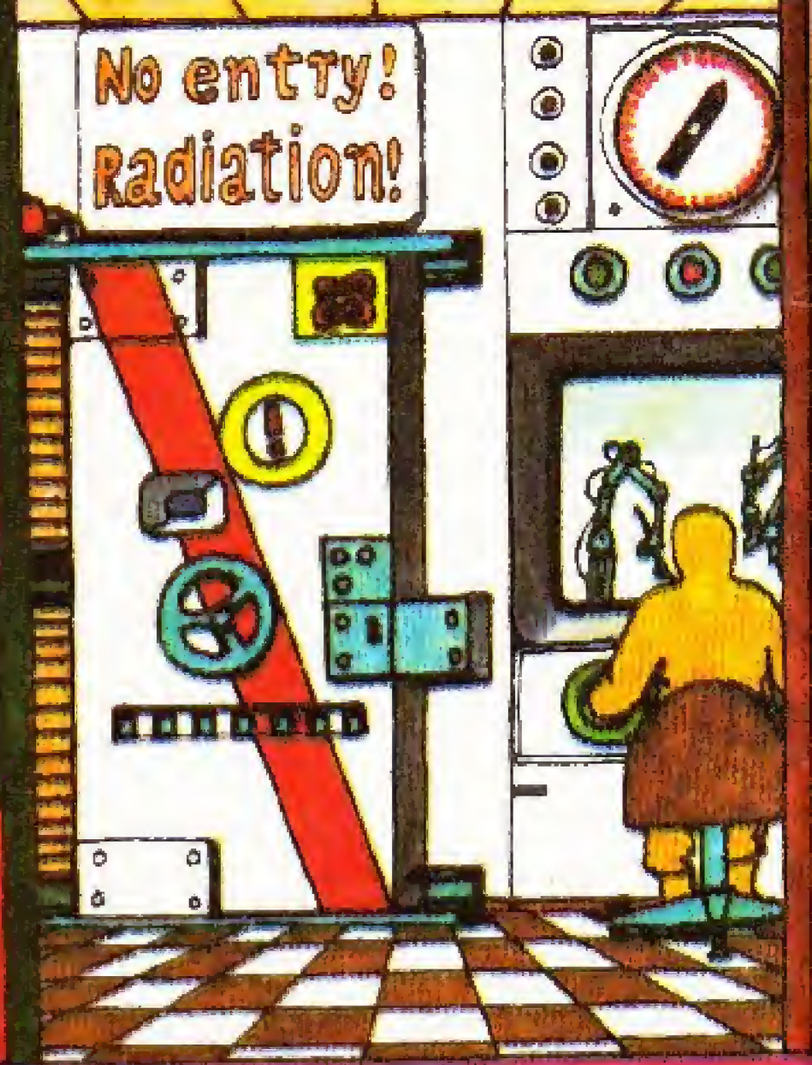


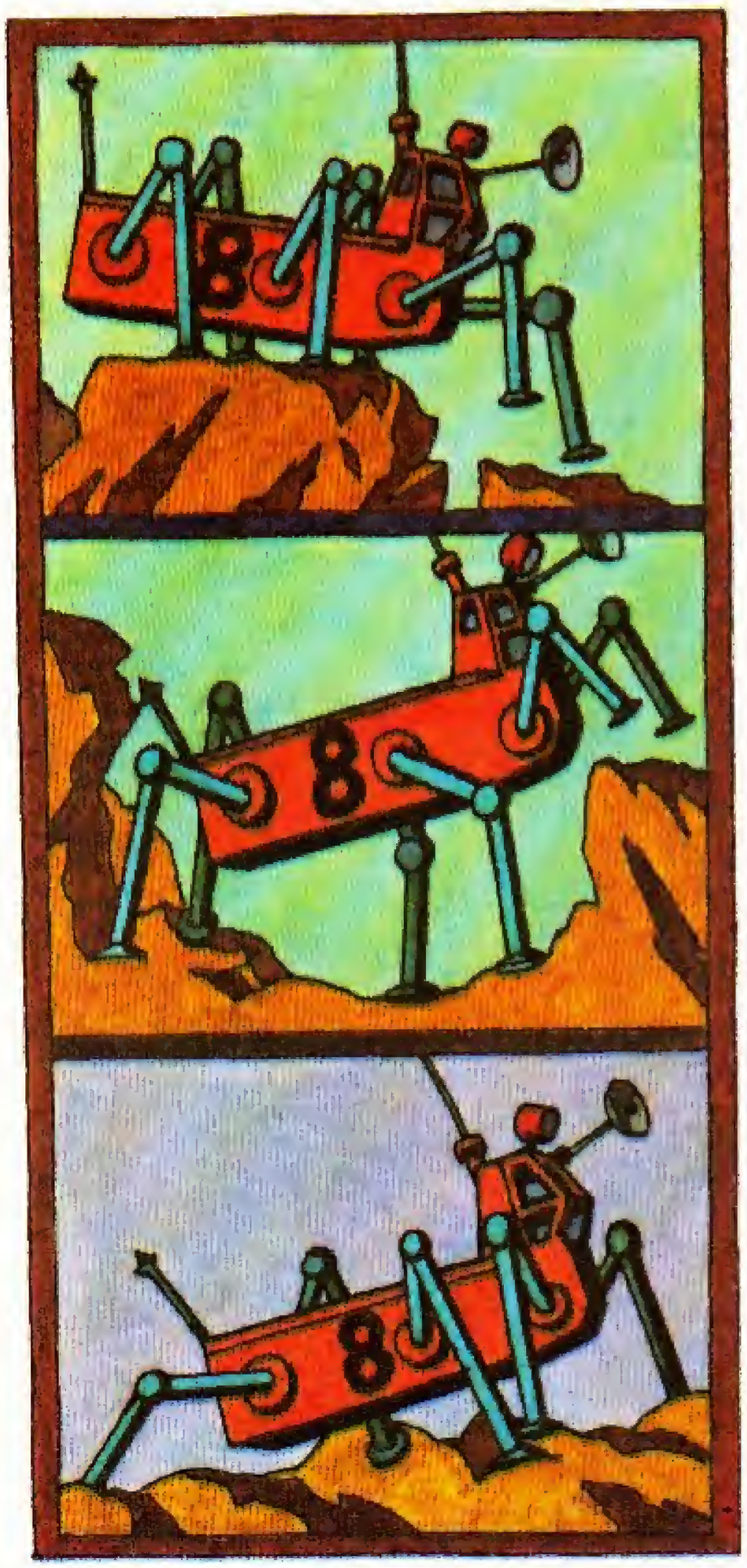
These machines
have six legs
and do not look like man.











paper, a rubber ball and a pebble on a table. Close your eyes and keep them closed. Touch the rubber ball... You say it isn't the ball? But what is it? The pebble? You're right. I am sure that even with your eyes closed you will never mistake a ball of paper for a rubber ball or a potato. Your fingers will tell you. They are clever.

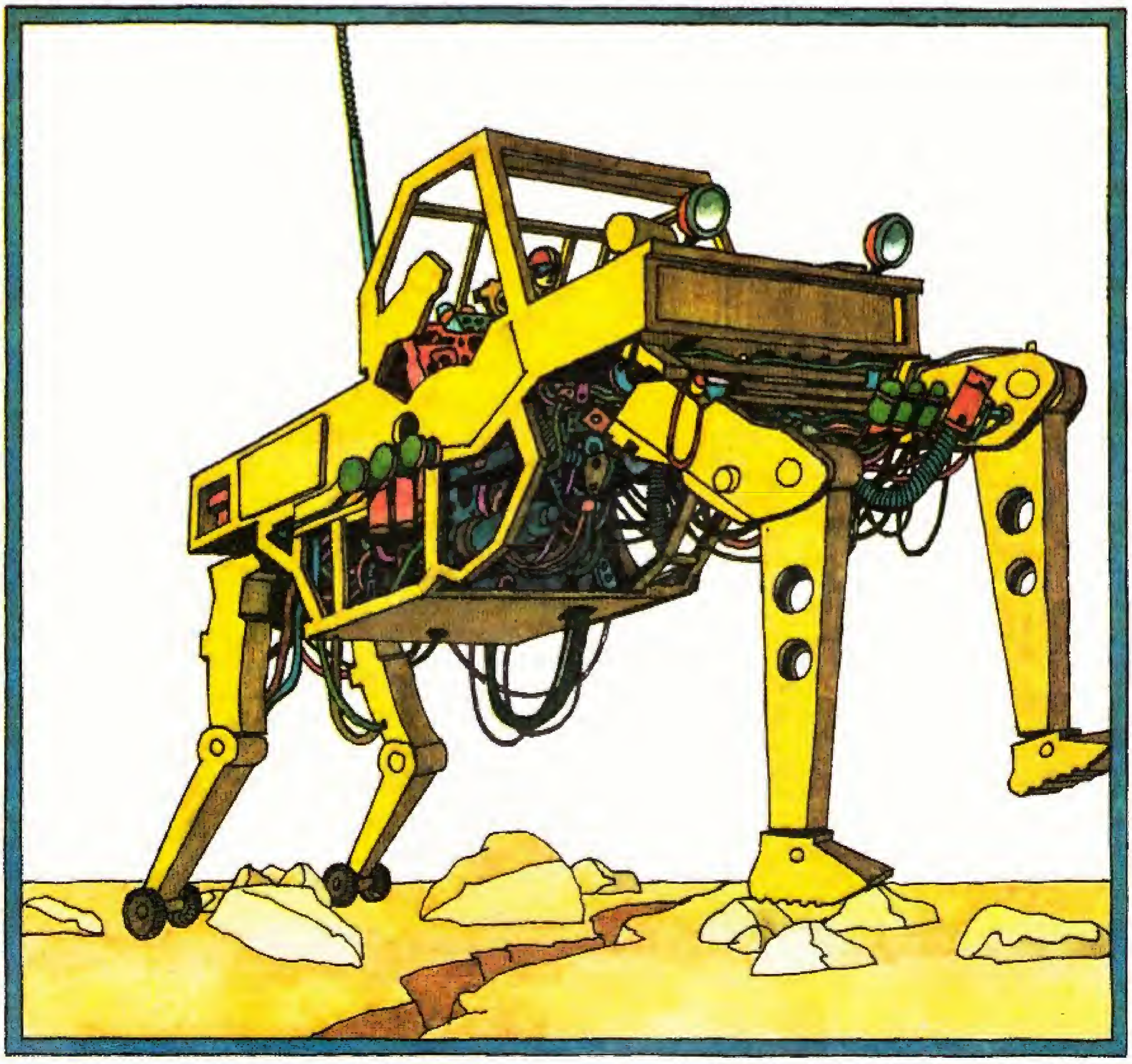
A robot also needs clever hands and fingers. You see, it might be given hands of iron that would crush a glass tube into dust, bend a steel bar into a useless crook, or break a wooden plank in half....

Strength alone is not enough. A robot must be able to tell a pea from a pebble, a bolt from a nut and a large building brick from a small one. And robots have been given such hands. Real hands that are strong, clever and hard-working.

Most other machines have wheels. Sometimes just one single wheel and sometimes many. But robots have been given legs and feet. Why not wheels?

Recently I saw a six-legged cross-

Robots replace people
wherever work is difficult
or dangerous.
They put out fires
and work underwater
and on other planets....



country vehicle. It looked like a crab. Its lever-like legs enable it to jump over boulders, stride over ditches and climb steep slopes.

A machine on wheels would never be able to drive over boulders, wide ditches or up steep slopes.

A legged robot, for example, is well suited for work in the mountains, where it can clear the roads of rocks, or on the sea bottom, raising sunken ships.

At atomic power stations robots walk into rooms which people are prohibited to enter.

A fire is raging. Black-and-red flames are leaping into the sky, roaring and hissing. A fearless robot fireman walks into the flames....

At forges, where heavy masses of red-hot metal are forged into shape, steel robot blacksmiths take charge of all the work.

Wherever it is hard, dangerous or simply impossible for man to work, robots come forward and help.

Thousands of years ago man invented the wheel. Quite recently he created the robot that looks like man.

Automatic machines see, talk, read, crawl, run and fly.

It was a long and difficult road from the wheel to the robot. Man wondered, daydreamed, sought and made mistakes and discoveries.

And what about tomorrow? What will man invent tomorrow? In ten or twenty years' time?...

No one knows exactly what machines will appear and what they will be called. But there is no doubt that they will be even more intelligent and astonishing.

Man will always seek, think, invent and build.

And so will you.

I'm sure of that!

Boris Zubkov

HOW THE MACHINE LEARNED THE ALPHABET

Illustrated by Boris Kyshtymov

Translated from the Russian by *Vladimir Korotky*
Malysh Publishers Moscow
Printed in the USSR